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AUTHOR Clarkson, W. W.; And Others
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ABSTRACT

This program consists of 25 modules and audiovisual materials incorporating information from engineering, soil science, agriculture, economics, and law. Contained in this instructor's manual are three modules to guide teachers and administrators who wish to utilize the program. Module one describes the preparations necessary for presenting the material in a workshop setting. Module two discusses the strategies which may be employed in conducting the workshop. The third module discusses the educational development theory underlying the program development and a number of variations in use that are possible. (CLS)

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Land Application of Wastes

An Educational Program

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Ithaca, New York

INSTRUCTOR'S PROGRAM
Modules A, B, and C

August, 1978

SE 029 203

LAND APPLICATION OF WASTES - AN EDUCATIONAL PROGRAM

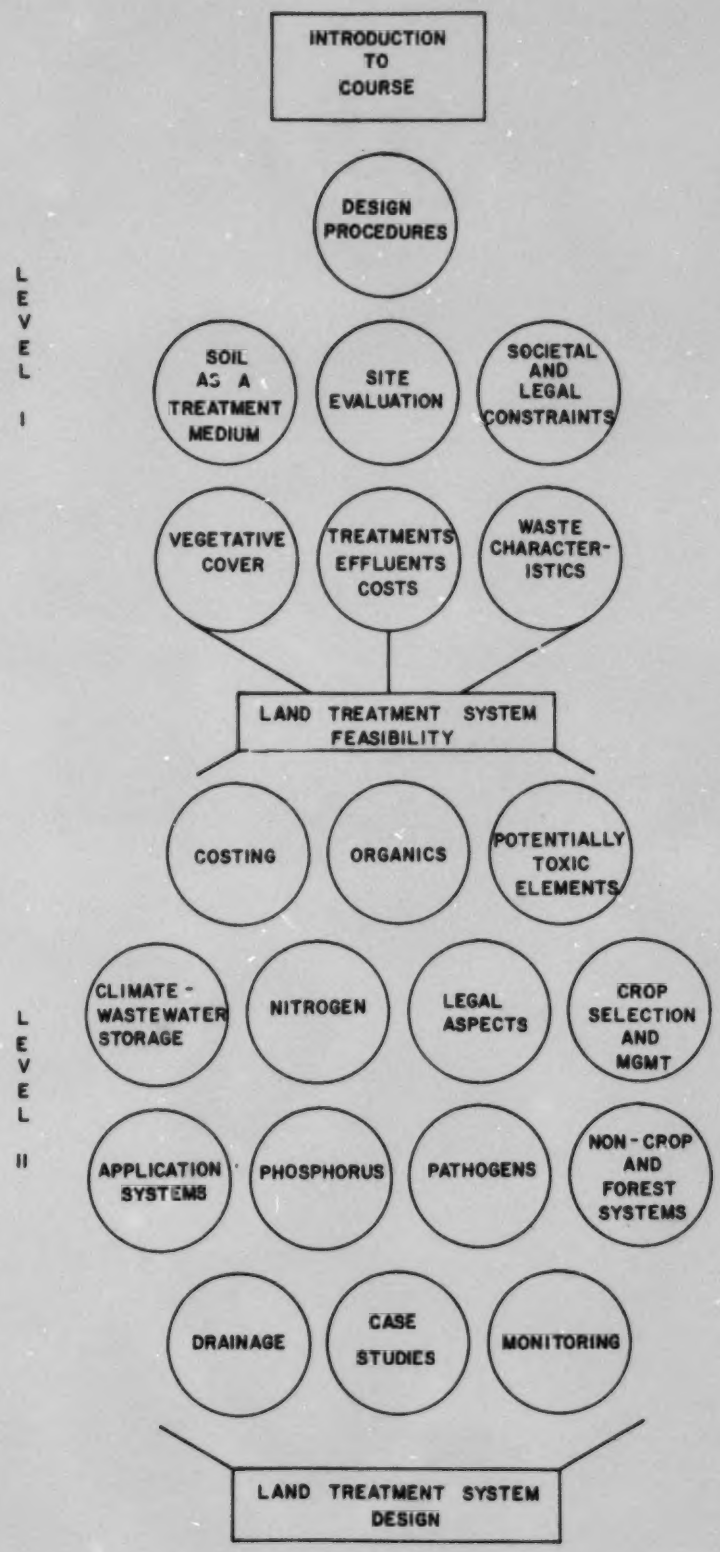
The objective of this program is to increase the knowledge of engineers, scientists, waste management specialists and other practitioners in the concepts and principles needed to properly utilize the potential of land for the application of wastes. It is designed for individuals concerned with waste disposal alternatives for municipal, industrial, and agricultural wastes. The modules in this Program incorporate knowledge from sanitary and environmental engineering, agronomy, soil science, agricultural engineering, economics, and law.

The program consists of some twenty-five modules and audio-visual materials as appropriate.

Questions about the Program can be directed to:

Environmental Studies Program
NYS College of Agriculture and
Life Sciences
Riley-Robb Hall
Cornell University
Ithaca, NY 14853

Telephone (607) 256-2008



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INSTRUCTOR'S PROGRAM

Modules A, B, and C

August, 1978

INSTRUCTOR'S PROGRAM

For Conduct of Workshops For The

LAND APPLICATION OF WASTES
EDUCATIONAL PROGRAM

Introduction to the Instructor's Program

Modules A, B and C

The Land Application of Wastes Program and this Instructor's Program
were developed in part with funds from the
Environmental Protection Agency and the U.S. Army Corps of Engineers

INTRODUCTION TO THE INSTRUCTOR'S PROGRAM

With the passage of PL 92-500 and with the reawakening interest in land treatment as a method of treating, recycling and reusing wastewaters, it was realized that there would be a great need for a comprehensive educational program on this topic. To design and operate successfully a land treatment system requires an understanding of basic principles relating to soil, climate, agriculture, and hydrology and the interaction of these with various components of sewage and sludge. These basic principles are not familiar to most persons associated with conventional treatment systems. If land treatment were to become a viable option within a reasonable amount of time, engineers and scientists would need an effective program for learning the principles and design approaches without returning to school for long periods.

Faculty and staff members from the New York State College of Agriculture and Life Sciences at Cornell University have developed the curriculum and learning materials for this educational program. The principal faculty advisors have backgrounds in civil, sanitary, and agricultural engineering, and agronomy. Other faculty members from soil science, law, economics, and agricultural economics also were involved. Since this program was such an educational undertaking, a professor of science education became one of the principal faculty members. The Land Application of Wastes Educational Program that resulted is, therefore, a total curriculum, that consists of several parts and takes advantage of the best that educational technology and theory has to offer.

It is very important that those who use this Program understand each part of the curriculum and the contribution that each part makes to the whole program. A fine tool properly used can help turn out a fine product, but misuse of a fine tool can also result in producing a poor product. This instructor's program, therefore, consists of three modules to guide teachers and administrators who wish to use the Land Application of Wastes Educational Program developed at Cornell University.

One module describes, in detail, the preparation for a four and one-half day workshop - utilizing the Land Application of Wastes Program. It might seem, at first glance, that the preparation for this type of activity

is self-evident. This is not the case, however, and preparation must begin three or more months before the actual workshop. The entire preparation will take more than one whole man-month. The amount of preparation will not be proportionately reduced for a workshop of shorter duration.

The second module discusses strategies for conducting the workshop. These include orientation activities, group assignments and dynamics, group discussions, evening activities, running a mock public hearing, group reports, and trouble-shooting. This module should be studied by all of the staff well in advance of the workshop.

The learning material that has been developed in the Land Application of Wastes Program can be used in a variety of ways as alternatives to a four and one-half day workshop. Some people may wish to add to the material or to tailor it to their own situation. The third module discusses the educational development theory underlying the development of the modules and a number of variations in use that are possible. This module also will be helpful to those who are considering developing their own modules since it indicates a method for designating important concepts and arranging those concepts for the most effective and efficient learning.

It is suggested that those who are unfamiliar with the Land Application of Wastes Educational Program, or those who are not familiar with all segments of the Program, review the Introduction to the Program, reproduced here from the published version of the printed materials. The Introduction to the Program would normally be distributed to the participants at a workshop. Reviewing this Introduction will make it easier to use the rest of the Instructor's Program because each segment that is mentioned in the following modules fits into the whole program in a specific manner.

Land Application of Wastes

An Educational Program

INTRODUCTION

Statement of Purpose

The purpose of this module is to acquaint the participant with the program of instruction entitled Land Application of Wastes: An Educational Program. This introductory module includes information on the content, structure, and alternative educational uses of the Program.

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Land Application of Wastes Program - A Brief Overview

In the nineteenth century it became relatively common for municipalities to operate "sewage farms." Some of those facilities were successful as measured by standards such as absence of excessive odors or standing water. Eventually, as urban expansion encroached on available land and technological interests turned to the design of sewage treatment plants, most sewage farms were abandoned. Since 1972, as a result of the passage of PL 92-500, land application as a waste management alternative has been re-emphasized. Legislative recognition of the importance of land treatment as an alternative technology for waste treatment was further emphasized by the passage in 1977 of the amendments to this law. Critical evaluation of those factors that impose specific limitations on the land application of wastes is needed.

Specifically, it is necessary to evaluate:

a) the characteristics of the wastewater and sludge

b) the impact of nitrogen, phosphorus, and potentially toxic elements on the soil system, vegetative cover, runoff water, and groundwater

c) the interactions between the soil system and wastewater constituents

d) the social and legal constraints

e) the effect of the proposed land application system on present and future regional land use patterns.

Thought must be given to designs employing combinations of conventional systems and land application. Such an evaluation must include the broad implications of the limiting factors with respect to both land application in general and to the specific site under consideration. Modification of specific waste characteristics, site conditions, and land use to relieve limiting features may be possible. Examples of such modifications might include underdraining certain soils so that larger hydraulic loads could be applied, wastewater pretreatment to reduce heavy metal content, or frequent cropping to achieve a higher rate of nutrient removal.

The Educational Program - Structure

The success of a land application system rests on scientific, legal, and social fundamentals and practices. It is necessary to integrate these items, to discuss their implications, and to provide a level of practical experience.

The objective of this educational program is to develop a better understanding of the capacity of the soil to assimilate wastes. The program is designed for engineers, scientists, planners, waste management specialists, and other practitioners in the area of environmental protection. Land application of municipal, industrial, and agricultural wastes is addressed. Knowledge from several disciplines, including sanitary, environmental, and agricultural engineering, agronomy, soil science, economics, and law are incorporated into the program. In order to present this diverse array of information in a meaningful way, this program is presented in modular format. This format also allows accommodation for variation in scientific training and experience of our target audience. The program is designed to be useful and understandable to individuals who have had no formal training in application of waste technology as well as for persons who have been involved with the design of successful land waste treatment systems.

The Modules

The basic unit of formal instruction is the module. A module is a self-contained learning packet focused on a specific concept, or a set of highly integrated concepts. Within the module, the program participant will find information on what he can expect to learn from the module, how the module fits into the entire program, and a discussion of the specific aspects of land application of wastes being addressed. Modules require from 0.5 to 3.0 hours of study time, with time depending in part on the reader's background and on the desired degree of mastery of the study materials.

While all modules are presented in a written format, fifteen have been adapted as audio-visual presentations, known at audio-tutorials, or A-T units. The audio-tutorials may be a core portion of the module, or they may be review or supplementary units. Written scripts are provided along

with the tape and slide A-T presentations, and several A-T units include supplementary booklets for further study.* The audio-tutorial units are supplementary in nature and need not be included in a study program. They are particularly valuable in workshops utilizing the Land Application of Wastes materials where they have been well received by participants.

Each module includes a set of learning objectives. These objectives indicate to the participants what he can expect to learn from the module. Thus, if the objectives of the module can be met by the participant without completing the module, then it is clear that this particular module can be passed over by the participant. Objectives are usually presented as a series of competencies which the participant will be able to demonstrate after completing the module. For example, an objective for this module might read as follows:

> After completing this module, the participant will be able to do the following:
>
> Describe the organization and content of the program, "Land Application of Wastes"; indicate how the printed modules that follow can be used in workshops, short courses, independent study, or in college courses in environmental or sanitary engineering.

The table of contents of each module is presented in outline form. This allows the participant to discover precisely what information is covered in the module, and where it is found. The reader should carefully peruse the major titles and their immediate subdivisions, and then reflect on how these topics might "fit" with respect to the existing knowledge and insights the reader has about the topic. Consciously trying to "fit" the general information about the module to one's own store of knowledge is the first and surest step to making effective use of the modular format. This preliminary effort is the most effective way an individual has to utilize the module so that it is supportive of, and integrated into, the knowledge of the reader. If the reader can complete only one or a few of the objectives of a module, the organization should allow him to identify sections in the module which would enable him to learn the material needed to complete the remaining objectives without the necessity of reading

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* Complete information and purchasing costs for the audio-tutorial program are available from the Instructional Materials Service, Stone Hall, Cornell University, Ithaca, New York 14853.

material already familiar. In addition to the learning objectives at the beginning of the modules, key ideas presented on subsequent pages are summarized in blocked out, italicized notes. This also facilitates targeting study efforts for efficient learning and/or review. A List of Tables and a List of Figures is also provided. Generally, following the outline and Table of Content information, there is a glossary of words, terms, and concepts which are used in the module.

Since each module is considered to be a self-contained learning packet, it is necessary for the reader to be sure he has learned the content of the module to a sufficient degree. By returning to the module objectives and assessing his competence in each, the reader is assured that he has in fact learned what was intended. If some of the objectives still cannot be satisfied, the reader has the option of returning to any or all parts of the written module or audio-tutorial for review, using italicized summaries as an aid to locating pertinent sections.

While each module is considered to be an individual unit, it must be remembered that all modules are designed to be an integral part of the entire educational program. Thus, there is extensive cross-referencing between modules. As the participant proceeds through the program, the individual modules will form an integrated package of information. The first ten modules are presented in Volume I of this program and the remaining eleven modules are included in Volume II. Let us now look at how the individual modules are integrated into the entire program.

The Design Procedure

In order to bridge the gap between an academic learning experience, such as this program, and the real-life situations faced by personnel in the field, a framework which approximates the design procedure used by engineers has been included in this program. The framework is described in the module, "Design Procedures for Land Application of Wastes" (Module I-2).

The design procedure identifies two levels of specificity. At the first level, general information is presented on all topics relevant to land application of wastes. However, this information provides an overview of land treatment technology, and by necessity many details are not included. Table 1 lists the Level I module titles.

Table 1. Introductory modules tend to center attention on broad topics and stress interrelationships between fundamental concepts.

	Title
Module I-1	* Soil as a Treatment Medium
Module I-2	* Design Procedures for Land Application of Wastes
Module I-3	* Waste Characteristics
Module I-4	* Treatment Systems, Effluent Qualities and Costs
Module I-5	* The Role of Vegetative Cover
Module I-6	* Site Evaluation: General Criteria - Information Sources
Module I-7	Costing Land Application Systems

* Also available as an audio-tutorial module.

After satisfactorily completing all Level I modules, the reader should be able to arrive at an initial feasibility decision for a specific design problem. At this point, the participant should be able to state what the limiting factor to land application may be for a given waste input and application site, what social aspects need further investigation, possible alternative sites for a land application system, and generally whether land application looks like a viable waste management alternative for that particular situation.

The reader is now ready for Level II. The Level II modules are more detailed, and contain information needed to arrive at more detailed design parameters such as specific hydraulic loads, application rate, land area needed, capital and operational costs, and so on. After completing Level II modules, a much more detailed problem evaluation is possible. Table 2 lists the titles of Level II modules.

Module and Program Sequences

The program consists of over twenty modules,* plus design problems. To be consistent with the philosophy of individualized learning in the Program, there is no formal sequence of modules. As noted, each module is a self-contained unit. To start the Program, choose one of the seven

* Additional modules will be prepared in the future and will become available either through the Instructional Materials Service at Cornell University or through Van Nostrand Reinhold Publishing Company.

Table 2. Level II modules provide more detailed information for completion of design problems.

	Title[1]
Module I-8	Societal Constraints
Module I-9	Legal Aspects
Module I-10	Case Studies Reviewed
Module II-1	* Nitrogen Considerations
Module II-2	* Phosphorus Considerations
Module II-3	* Organic Matter
Module II-4	Potentially Toxic Elements
Module II-5	Pathogens
Module II-6	* Climate and Wastewater Storage
Module II-7	* Crop Selection and Management Alternatives
Module II-8	* Non-crop and Forest Systems
Module II-9	* Waste Application Systems
Module II-10	* Drainage for Land Application Sites
Module II-11	* Monitoring at Land Application Sites

* Also available as an audio-tutorial module.

[1] Volume I of published program contains Modules I-1 to I-10, and Volume II contains Modules II-1 through II-11.

Level I modules. Since there is no rigid sequencing, the Level I modules may be completed in any sequence desired, although the numbers of these modules may designate a preferable sequence. The Level I modules can be completed in 3 to 9 hours of study time.

It is suggested that the reader assume that he has been approached by a municipality or an industrial firm for advice about a proposed land application system (such as offered in the sample design problems). With this focus, intelligent questions can be raised and pertinent information can be gathered and related to the information in the modules.

The design problems are included only to provide a real focus for the fundamental information and to place the information in a real rather than abstract context. The reader should not consider solution of the design problem to be the most important part of the Program. The design problem is merely to facilitate the acquisition and use of the basic information.

The Educational Program - Alternatives

Whereas the modules contain a large portion of the current knowledge of land application of wastes and can be read somewhat in the fashion of a textbook or symposium volume, they are also designed to be used in a variety of educational programs. The psychological and social factors that were considered in the design of the modules is presented in an Instructor's Program.*

Workshop Programs

Workshop programs draw together a group of participants, with varying interests and backgrounds, for a short, intensive period of study. Most workshop programs constitute a series of lectures by "experts", with some opportunity for questions and discussions. The Land Application of Wastes Program has been designed to be used effectively in a two to five-day workshop that includes individual study of printed and audio-tutorial modules, staff tutoring, small group problem solving sessions focused on representative design problems, some guest lectures and special group presentations and correlated individual and group activities. A sample schedule for a five-day workshop is shown in Table 3.

The staff represents one major source of guidance and information. Sufficient staff must be provided to meet each participant's need for guidance as quickly as possible. Guest speakers - experts with various backgrounds in specific and general aspects of land application - are part of the Program to serve as additional resource personnel. Participants are encouraged to interact individually or in groups with these speakers. The fellow participants represent a wide range of pertinent knowledge and experience. While each participant is recognized to be moving through the Program as an individual, the Program format is designed to encourage interaction and support.

Participants will be given realistic design problems based on the scenario of a client approaching a consultant with some limited information

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* The Instructor's Program consists of three modules describing the organization and conduct of "workshop" educational programs, some alternative programs, and the theoretical rationale for the Program as developed. The Instructor's Program is available from the Instructional Materials Service at Cornell University.

Table 3. Schedule for a typical workshop

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 a.m.	Registration, Welcome, Introduction to Program	Level I Design Procedure-Limiting Design Factors	Introduction to Level II	Group Discussion if needed-alternative systems	Prepare Level II Design
9:00	Written & A-T Modules, Design Problems	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	Presentation of Level II Designs
9.30		XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	
10:00	Coffee	Coffee	Coffee	Coffee	Coffee
10:30	Level I XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	Discussion & Evaluation
11:00	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	↓
11:30	XXXXXXXXXX	Complete Level I Topics	Discussion-Pathogens & toxic elements (or nitrogen)	XXXXXXXXXX	
NOON	Lunch	Lunch	Lunch	Lunch	Adjournment
1:00 p.m.	Speaker	Speaker	XXXXXXXXXX	Speaker	
2:00	XXXXXXXXXX	Prepare Level I Design	XXXXXXXXXX	XXXXXXXXXX	
3:00	XXXXXXXXXX	Presentations of Level I Designs	Field Trip (optional)	XXXXXXXXXX	
4:00	Design Problem Definition & Review of Format & Early Problems	Discussion of cost effectiveness & pollution control efficiency	↓	Level II Modules, Complete Public Hearing	
5:00					
7:30	Evening Program				

XXXXXXXXXX - denotes time set aside for individualized study with tapes, slides, written material and other prepared material. Individual course instruction and tutoring are also available at these times.

at hand and requesting advice on the feasibility of land application to solve a given problem. Sample design problems are included in Module I-2, "Design Procedures for Land Application of Wastes". Each participant will be asked to select one "interesting" situation for study and the participants will be divided into study teams. Each team will meet with a staff member and begin to consider the problem. The staff member will act only to gently direct the discussion if it strays too far off target. He or she will act as a resource person to indicate where specific information may be found. The staff member is not to supply factual answers except when necessary to avoid delays in the Program. Working together, the team should develop the background information necessary to assess the general feasibility of land application for the specific problem (Level I). A more detailed analysis and feasibility will occur in the subsequent part of the Program (Level II).

Each study team presents reports to the total workshop group to report progress on their design problem and to solicit comments and criticism. Field trips and other activities may be included in a workshop program.

Independent Study

For most professionals, independent study in their office or home is the most common form of education. The Land Application of Waste Program was designed to be an effective educational tool for use by professionals who wish to study on their own. It can be used either with the printed modules only or in combination with audio-tutorial units that may be purchased through Cornell University or loaned from regional offices of the Environmental Protection Agency. In the future, we anticipate that some colleges and universities will offer faculty assistance through home study or extension education programs to assist the independent learner. The study time needed to meet the objectives given in all modules will vary depending on an individual's background and experience with a reasonable range of 30 to 100 hours of study time.

Short Courses and Other College Offerings

Some colleges and universities are offering "short courses" in land application of wastes technology. These courses fit into summer session or other college program offerings and usually carry undergraduate or graduate credit. Both the printed modules and the audio-tutorial modules

are used to supplement semester courses in waste treatment technology. The materials have been designed to be used effectively in conjunction with formal college courses.

To Begin The Program

We advise the reader to begin by "thumbing through" all of the modules, giving a few minutes to each module and stopping occasionally to read italicized summaries or to study a figure or table. Then turn to page 00 of Module I-2, "Design Procedures for Land Application of Wastes" and look over the sample design problems here. An understanding of fundamental concepts necessary for the solution of these kinds of problems are the final criteria of effective learning, and hence a major goal of this Program. Then we advise that you begin with Module 1, "Soil as a Treatment Medium," and proceed from there as you deem most appropriate. The authors would be pleased to learn of your success or difficulties with this Program.

****
* INSTRUCTOR'S PROGRAM *
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Module A

PREPARING FOR A WORKSHOP

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OBJECTIVES

Upon completion of this module, the reader should be able to:

(1) Recognize major preparation needs that together require a 14-week planning period.

(2) Identify key concerns for selecting workshop study rooms and lodging facilities.

(3) Know how to arrange space for general sessions, workgroups, and audio-tutorial study.

(4) List responsibilities of staff members and characteristics desired in staff.

(5) List equipment needs and sources of equipment.

(6) Know sources of maps and other materials needed for design problems.

(7) Prepare a workshop evaluation form.

PREPARING FOR A WORKSHOP

INTRODUCTION

The Introduction to the Program Module of the Land Application of Wastes Program provides an overview of the program and this should be studied first.

Each part of a workshop involves extensive preparation time. Design problems must be developed, publications obtained, speakers arranged, staff trained, rooms reserved, participants invited, and so on. It is always surprising how long the time arrangements take. This module indicates a time line for preparing for a Land Application of Wastes workshop. For many of the arrangements that have to be made, the time indicated in the module is a last practical date if the preparations are going to proceed smoothly.

Adequate time for advance planning is essential.

If a workshop of a shorter duration is being considered, the arrangements may be simplified; the time necessary for planning, however, will still remain generally unchanged. Speakers must still be contacted far in advance and potential participants invited.

TIME LINE FOR WORKSHOP PREPARATION

Figure 1 indicates an abbreviated format for a 5-day Land Application of Wastes workshop. As can be inferred from this figure, the objective of the whole program is to have the participant in the workshop understand the fundamentals or basic concepts of land treatment as well as how to utilize them in practice. Each activity in a workshop contributes to the objectives--the modules deal with the fundamentals and their use in practical situations. The rationale for the program and module design is discussed in detail in Module C of this Instructors' Program.

The objective of the program is to have the workshop participant understand the fundamentals of land treatment as well as how to utilize them in practice.

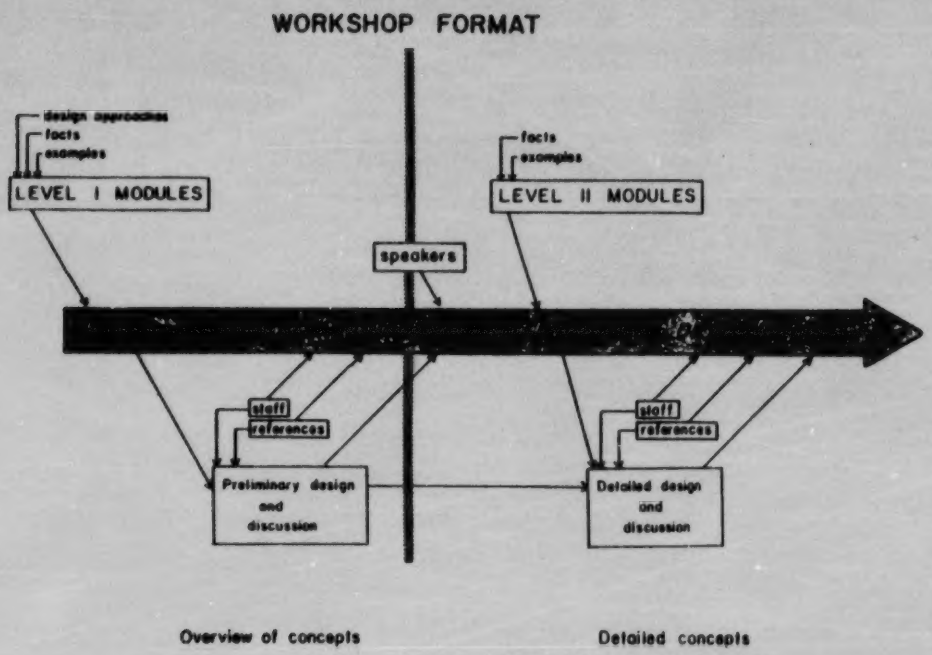

Fig. 1. Schematic format for a Land Application of Wastes workshop showing the emphasis of all segments of the program on basic principles underlying land application systems.

Table 1 indicates a schedule for a typical workshop. Notice that there are several different kinds of activities indicated on the schedule. A typical Land Application workshop involves self-study and small group work subtly guided by a tutor, group meetings to hear distinguished speakers and to discuss particular topics, reports given by the small groups to the rest of the participants, a simulated public hearing or discussion of public acceptance, and possibly one or two evening programs. This results in an intensive workshop that is unlike those generally offered for the professional in any field. If each of the parts of the workshop is to perform its function and contribute to a successful workshop, adequate preparation time is needed.

Activities include self-study, small group work, and larger group meetings for discussions, lectures, and reports, a simulated public hearing, and one or two evening programs.

A sample schedule for planning a workshop is indicated in Table 2. Notice that the planning must begin <u>at least</u> three months before the date for the projected workshop. It is expected that some of the planning will be completed before the identified time. One person should have the responsibility of seeing that all of the items on the schedule are being arranged. Unless there is a particular person in charge, some items may be delayed or perhaps not get done.

Planning must begin at least three months before the date of the projected workshop.

TABLE 1

SCHEDULE FOR A TYPICAL WORKSHOP

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 a.m.	Registration, Welcome, Introduction to Program	Level I Design Procedure-Limiting Design Factors	Introduction to Level II	Group Discussion if needed-alternative systems	Prepare Level II Design
9:00	Written & A-T Modules, Design Problems	XXXXXXXXXX	Level II XXXXXXXXXX	XXXXXXXXXX	Presentation of Level II Designs
9.30		XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	
10:00	Coffee	Coffee	Coffee	Coffee	Coffee
10:30	Level I XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	Discussion & Evaluation
11:00	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	↓
11:30	XXXXXXXXXX	Complete Level I Topics	Discussion-Pathogens & toxic elements (or nitrogen)	XXXXXXXXXX	
NOON	Lunch	Lunch	Lunch	Lunch	Adjournment
1:00 p.m.	Speaker	Speaker	XXXXXXXXXX	Speaker	
2:00	XXXXXXXXXX	Prepare Level I Design	XXXXXXXXXX	XXXXXXXXXX	
3:00	XXXXXXXXXX	Presentations of Level I Designs	Field Trip (optional)	XXXXXXXXXX	
4:00	Design Problem Definition & Review of Format & Early Problems	Discussion of cost effectiveness & pollution control efficiency	↓	Level II Modules, Complete Public Hearing	
5:00					
7:30	Evening Program				

XXXXXXXXXX - denotes time set aside for individualized study with tapes, slides, written material and other prepared material. Individual course instruction and tutoring are also available at these times.

TABLE 2

TIME TABLE FOR PLANNING A WORKSHOP, AND A CHECKLIST FOR MAJOR PREPARATION ACTIVITIES

Time Prior to Workshop	Major Preparation Activities
14 Weeks*	Space arrangements; Selection of Staff; Motel accommodations arranged; Prepare brochure describing the workshop.
13 Weeks	Arrange for guest speakers.
12 Weeks	Advertise workshop; Invite participants; Develop design problems
11 Weeks	Order audio-visual equipment; Arrange field trip.
10 Weeks	Order written and audio-tutorial modules; Order additional publications needed; Order boxes for hand-out materials.
9 Weeks	Order reference materials for design problems: (1) soil surveys, (2) climatic information.
8 Weeks	Order reference materials for design problems: (1) topographic maps, (2) land use information.
7 Weeks	Arrange for equipment needed for workgroups and room set up.
6 Weeks	Staff review of design problems.
5 Weeks	Assemble reference books.
4 Weeks	Arrange for arrival of participants (i.e., transportation from airport); Order coffee and tea; Send introductory letter.
3 Weeks	Prepare packets of material for participants; Prepare introduction to workshop; Prepare schedule for workshop.
2 Weeks	Prepare evaluation forms; Prepare public hearing simulation; Prepare name tags.
1 Week	Prepare individual boxes for packets of material for each participant; Confirm field trip and transportation; Set up A-T materials in room; Set up room for workgroups; Check A-V equipment.

*14 weeks should be the minimum for these to be completed. In most cases, these should have been completed long before 14 weeks. Six months might be right for publicity, inviting participants, and arranging space.

Fourteen Weeks Before--Space, Staff, Accommodations Space

Space. Several combinations of rooms can be made suitable for holding a workshop. At least two large rooms are necessary for a workshop with 30 to 35 participants. One large room and two or three smaller rooms can also be made suitable. Figure 2 indicates a set up that is close to ideal using two large rooms. The group workroom in this case contains 270 square feet for each workgroup. Notice that the room not only has space for the actual group work, but also contains a coffee area and a reference area, as well as a table where the staff and participants can meet informally during the day. An area for the staff to meet for a brief time is desirable so that they can discuss issues that arise during the workshop and that demand immediate attention. The audio-tutorial (A-T) room contains the equipment for the A-T modules along with the meeting room facilities. In the case of Figure 2, there is no area to store the A-T modules in the A-T room so they are stored in the workroom.

Several room arrangements are possible. Consideration must be given to work, coffee, reference, and A-T areas, as well as a table for informal staff and participant meetings.

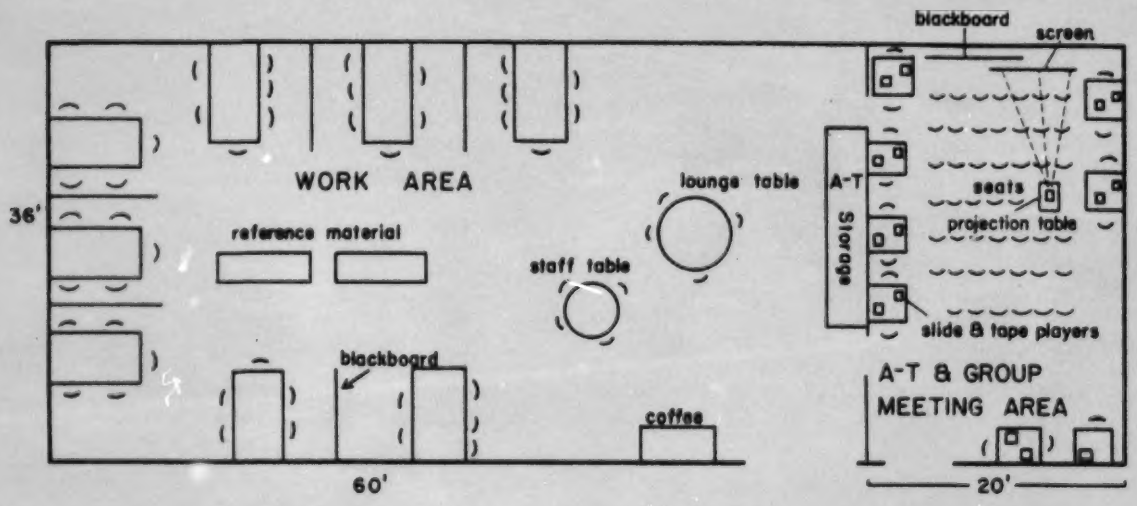

Fig. 2. Arrangement for workshop for 30-35 participants using two large rooms.

Figure 3 shows another room arrangement that is very convenient to use. In this case the coffee area and the lecture-discussion room are separated from the workrooms. There is still more than 175 square feet of floor space for each group in the group workroom.

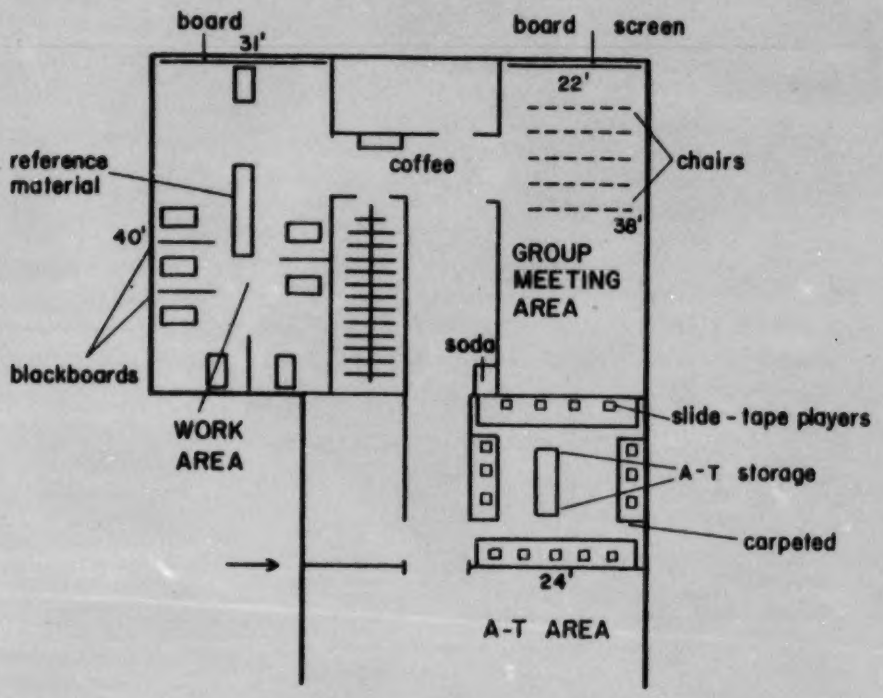

Fig. 3. Alternative room arrangement with separate rooms for workgroups, A-T use, and lecture-discussions.

The following is a list of amenities for which to look when choosing rooms for a workshop:

1. Main Group Workroom

(a) sound deadening material on the ceiling, walls, or floor. This can be carpeting on the floor, sound absorbing walls or ceiling.

(b) adequate overhead light for all areas of the room. Because the blackboards divide the room to a great extent, each group needs light fixtures over it.

(c) adequate electrical outlets. There is usually somebody in a group who will want to plug in a calculator or use a piece of A-V equipment.

(d) if the room comes furnished with chairs, be sure they are comfortable since people will be sitting in them for a long time each day.

There are some important factors to consider in choosing the workshop location, i.e., proximity to restaurants and room accommodations, adequate lighting, ventilation, and electrical outlets, etc.

2. A-T Room

(a) adequate ventilation is important because each slide-tape player produces a significant amount of heat.

(b) there must be a number of electrical outlets throughout the room or extension cords will have to be used. Check on location of fuses or circuit breakers.

(c) carrel units, if built in, must be large enough for the participant to take notes and keep the lesson package handy.

(d) the room must be secure at night. The audio-visual equipment is expensive.

3. General Location

(a) the workshop should be close to the room accommodations, if most participants are from out of town.

(b) restaurants, for lunch, should be within easy walking distance.

(c) the workshop rooms should be close to each other. This makes it easier on the staff and the participants.

(d) be sure there are conveniently located restrooms.

(e) participants may want to work in the evenings. Try to make the facilities available after dinner.

(f) adequate ventilation to clear cigarette smoke.

(g) rooms with windows are preferred

Actually, several configurations and sizes of rooms are possible. It is preferable for all of the group work to be in the same room. The groups must share references, and the staff will be sharing knowledge and helping various groups. This is much easier if the groups are all in the same room. Partly for this reason, accoustical qualities of the room are important. The A-T equipment should also be separated from the group workrooms. This equipment is noisy and distracting to people who are not using it at the time.

Space to hold the workshop should be found and reserved at least three months before the scheduled date of the event. If conduct of the workshop is dependent on outside participants, however, be sure that the reservation can be cancelled up to two weeks to a month before the scheduled date. In this way, if the response from potential participants is not adequate, the workshop sponsors will not be committed to unnecessary space and cost.

Staff. An effective staff is one of the keys to a successful workshop. It is essential for the staff to be very knowledgeable concerning land treatment and conventional treatment. They should also become completely familiar with the Land Application of Wastes written and audio-tutorial modules. When the participants in the workshop have questions concerning any phase of land treatment, the staff must not only know the answer but must also know where the information is found in the modules.

An effective staff is one with technical knowledge, familiarity with the program, and skill in interpersonal communication.

Knowledge of the modules and treatment processes, however, is not enough for an effective staff. A workshop depends upon the staff's ability to work with individuals and groups in a dynamic situation. To a great extent, teaching experience develops the ability to function in this kind of situation. It is important for the staff to know when to encourage groups and individuals, when to give an answer or to have the group work out a solution. There are few problems that have a single solution in a workshop, so the staff must be creative, flexible, and able to react quickly.

For the first workshop that a team conducts, there should ideally be a staff member for almost every workgroup. That means that one person will be responsible for four or five participants. This ratio is more important if the participants are unfamiliar with land treatment. It will be found, after some experience, that a staff member can handle two workgroups. This calls for a staff person for every ten participants, or three or four for a typical workshop with 35 participants. Each staff member should become familiar with all of the design problems, and specialize in one of them. The best way of becoming familiar with a problem is by running through it, using the modules and references that will be at the workshop to solve the problem. This will result in a particular solution, but other solutions will be possible. It will also allow the staff to become familiar with the problem and the information that is available concerning that particular situation.

Room accommodations. If there are a number of people attending from out of town, it is wise to reserve a block of rooms. Usually a discount can be obtained on the room rates. It is convenient to have the evening activities in the motel or hotel meeting rooms. Make sure that there are meeting rooms available and ascertain if they can be equipped with blackboards, projection screens, 16 mm and slide projectors, and extension cords. The availability of this equipment will help in planning for evening programs. Usually, some of this equipment will have to be obtained from outside the accommodations site. Some motels and hotels provide meeting rooms at no charge, since many of the guest rooms are being used by participants. Obtain written confirmation of meeting room space and charges (if any) in advance.

Room accommodations should be scheduled well in advance of the workshop. Check for equipped meeting rooms, restaurant facilities, and convenience in planning evening activities.

It is also helpful if the housing accommodations are within walking distance of the main workshop location. This allows the participants the option of working later in the evening without concern for transportation. It is also convenient if the room accommodations are located near restaurants so the participants can have a choice of eating places. Eating in the same restaurant can become monotonous after a few days. In addition, many people would rather not pay motel/hotel restaurant prices for meals and will eat elsewhere. The motel/hotel restaurant facilities for breakfast and dinner should be evaluated. Slow service will be very irritating to the participants and can ruin a well-planned schedule.

As with the rooms for holding the workshop itself, be sure that you can cancel any reservations for room accommodations, if the response from participants is less than adequate.

Thirteen Weeks Before--Speakers

A "distinguished" speaker may be scheduled in the program every day, preferably after lunch or the first session in the morning. This timing will help organize and orient the group and also permit group discussion and questions. The talks should concern areas of special interest to the participants or update information that is in the modules. The modules were as up-to-date as possible at publication, but the field of land application is evolving so fast that several sections will be outdated

"Distinguished" speakers should concentrate on areas of specific interest to the participants or update information in the modules.

no matter how often they are revised. Some of the topics for which an update is needed or experience has been found favorable are monitoring, operation and maintenance, hydrology, current EPA guidelines and funding, pathogens and public health, potentially toxic elements, and forest and wet-land systems. The speaker should have firsthand knowledge about the subject and be a person recognized in his field. Because there is much to do in a brief workshop, the speaker must be interesting and relate to needs of the participants.

The ideal situation is to have the speakers arrive at the workshop at least a day in advance of the talk and remain the rest of the day after it is finished. In this way the speaker can add his expertise to the other information that the workgroups are receiving. Some speakers will work closely with the groups on an individual basis, and, if they do not give suggestions that conflict with the information in the modules, this can be of great benefit to the participants in the workshop and is greatly appreciated.

Selecting speakers is often a major problem. Unless you are personally familiar with many people in the field of waste management, you will have to resort to other persons' recommendations. To minimize the hazards in this, we suggest the following procedures:

(1) Check recent issues of important professional journals to identify potential speakers who are knowledgeable in subjects of interest to you. This job can be done in part by a student or aide.

(2) If you know people in the same department or unit as the potential speaker identified in (1), telephone this person and get his counsel on the speaking ability and enthusiasm of the candidate.

(3) When a list of potential speakers is identified, call "experts" in the field and get their opinions. One way to proceed, if you are not familiar with experts in the field, is to call the persons identified in (1), asking their opinions about the other potential speakers. You may "kill two birds with one stone" if you also learn of new speaker candidates who rank better than those on your list, or if the person you contact volunteers his participation. One hundred or so dollars spent on phone calls may be your best investment in preparation for a good workshop.

(4) Confirm all arrangements in writing, including exactly when the person is expected, for how long, and what compensation will be provided.

Current journal articles and telephone calls to the authors and other experts can be useful in selecting speakers.

Twelve Weeks Before--Invite Participants, Develop Design Problems

Participants. Advertising and publicity for a workshop should begin well in advance of this time. The program is designed for professionals who are familiar with one or more aspects of waste treatment. Many of the participants will be engineers and other professionals who are associated with preliminary planning, design, regulation, or operation of a land treatment facility.

All of the participants should make firm commitments to attend the program at least a month before it begins. Requesting a deposit or registration fee from the potential participants assures the sponsors of a firm commitment. This will help decide if adequate staff has been committed and can allow the workshop sponsors to verify space and equipment reservations.

Participants for the workshop should be asked for a registration fee as an indication of a firm commitment.

Design problems. Although the purpose of the Land Application Program is to teach the fundamental concepts concerning land treatment, the workshop groups focus their attention on a problem in waste treatment throughout the workshop. This problem helps to focus the learning and allows it to become practical rather than theoretical. By the end of the workshop each group should have developed a preliminary design for a cost effective treatment facility. Thus, the development of the design problems is an important part of the preparation for a workshop.

The development of the design problems is the necessary element in relating the practical to the theoretical. Several methods are possible in developing the problems, all of which should culminate in a preliminary design for a cost effective treatment facility.

A design problem consists of a narrative portion that describes the community or area that is the problem location, a portion that indicates the composition of the wastewater or sludge, the current treatment method and composition of the effluent, and the requirements that are causing the problem. There is also a portion of the problem that indicates climatic parameters such as precipitation and mean monthly temperatures. Examples of two design problems are indicated in appendix A. It is preferable to have the design problems be of varying degrees of difficulty and relate to the regions that would be most interesting to the participants. The problems in the appendix were developed for a workshop in New York State and another in California, and this influenced the choice of the problems.

Design problems can be developed in several ways. One way is to develop an actual local situation into a problem. Another way is to modify a situation in order to create a design problem that will be challenging. A third method is to make up a fictitious problem for an actual community. This last method is the most difficult because the problem must match an actual community for which there are topographical, land use, and soil maps, as well as climatic data.

If there is adequate land area available, almost any size community can be used for a design problem. Smaller flows of municipal sewage almost always present a good case for land treatment, but our previous workshops have used design problems with flows up to 65 mgd with success. The kind of problems that should be sought are ones in which there is not a great difference between the cost of land treatment and conventional treatment. In many cases, this reflects the actual situation for a community considering a new treatment facility. Problems have been used in past workshops which, on the face of it, seemed clearly to favor conventional treatment. The design groups have, however, developed land treatment systems for these problems that were plausible and cost effective.

It is always wise to develop more design problems than is thought to be necessary for the workshop itself. Information for each problem must be ordered and often some of the essential pieces may be missing for one or more of the problems. Developing extra problems gives the instructor some leeway in the final choice for the workshop. Previous workshops have used the design problems in two ways. One way is to have each workgroup work on a different problem. The other way is to have two groups work on the same problem but work separately. The participants have generally found the latter procedure to be more interesting because they could see the different ways of dealing with the same problem. It also makes the presentations more interesting since there is one group that has the information to challenge the assumptions and solutions of another group.

It is advantageous to overestimate the number of design problems needed. Each group may work on an individual problem, or two groups may work simultaneously yet separately on the same problem.

Nitrogen or hydraulic loading are the limiting waste constituents for land treatment in most of the design problems and most of the actual land treatment systems using municipal wastewater. In certain sections of the country the sponsors may wish to develop design problems with dissolved solids or cadmium as the limiting constituent in the waste, or where the sites are limited in some way. As long as the design problems can be used as a practical focus for the concepts presented in the learning program, they will be valuable to the participants at the workshop.

A good reference to use to determine the feasibility of using a particular design problem is a soil survey of the area. These are available at most state agricultural college libraries. A soil survey can be used to ascertain the general soil characteristics, land availability, and general information about the climate of the area. If there is enough available land with a reasonable slope then the problem is probably worth pursuing. Topographic maps and climatic information are also generally available at agricultural and other college libraries. These publications may only be available for reference in the library.

A soil survey, available at most state agricultural college libraries, is a good reference in determining the feasibility of using a particular design problem.

Eleven Weeks Before--Audio-Visual Equipment, Field Trip

Audio-Visual Equipment. Appendix B indicates the audio-visual equipment that is needed for a typical workshop. In large cities, most of the audio-visual equipment can be leased from a company that specializes in that kind of business. If a company cannot be found locally, then a call to the head office of one of the equipment manufacturers can put the sponsor on the track of a company that does lease audio-visual equipment. On large college campuses there is usually a media department that can provide equipment on a charge basis.

Audio-visual equipment can be leased from local companies or college media departments. One slide-tape player per two participants should be adequate.

The audio-tutorial modules of the Land Application Program have always received very enthusiastic response from the workshop participants. Unless a slide-tape player is provided for each participant, there will, at times, be a shortage of this equipment. This, however, is not practical. A slide-tape player for every two or even three participants has been found to be an adequate compromise. For a 5-day workshop, the slide-tape players will be very heavily used on the first day for the Level I modules and on the third and fourth days for the Level II modules.

The slide projector will be used by the distinguished speakers and for the evening program. The 16 mm movie projector may be used in the evening program, if films have been ordered. If a large audience is expected, a sound system may be necessary for the speakers. The cassette recorder-player may be used to record presentations. A patchcord to enable the cassette tape, played on the cassette recorder, to cue slides in the slide projector is necessary for playing the introductory A-T module to the participants on the first day.

Be sure that replacement bulbs and fuses come with all equipment, and that the equipment is tested before the beginning of the workshop. Because the slide-tape players receive so much use, there are bound to be one or two bulbs that must be replaced. This is a simple job that one of the workshop staff should learn to do before the workshop. Check on the availability of prompt repair service from the vendor of the A-V equipment in case of major breakdowns.

Field trip. A field trip is a welcome break from the more than eight hours a day spent working in a few rooms. It also helps the participants apply some of the concepts they are learning and to see land application firsthand. The best time for the field trip is the third day of a 5-day workshop. The participants have been through Level I and, if held in the afternoon, may have started Level II. This gives them enough background to relate what they will see to what they have learned and to evaluate the system.

The field trip should take no longer than one half of a day including travel time. This will eliminate the field trip for many workshops, since there may not be a land treatment site close enough. It will be difficult to find a well designed site. Most of the sites will be overdesigned, with the land application being an add-on for water disposal rather than waste treatment. This, however, should not rule out the field trip. The purpose of the field trip is to relate the basic principles concerning land treatment to the field trip situation and an over- or underdesigned site can be useful for this purpose.

The first step in arranging a field trip is to find land treatment sites within a reasonable distance. These can be found by contacting the closest EPA Regional Office, the state Department of Environmental Conservation, or the head of the local sanitary district.

The second step is to contact the head of the particular land treatment system(s) and either get a description of the system or arrange to visit the site personally in advance. The site should be accessible and convenient to get around to see all of the operation. If the site will make a good field trip, then arrange the date and time with the person in charge of the site. Usually, employees of the land treatment facility will conduct a tour for your participants. If you have more than ten or twelve participants, it is advisable to divide the group into two or more sections, starting at different points in the system. This avoids overcrowding at the different points and speeds up the visit. The arrangements, including date, time, meeting place, tours, and staff to conduct the tour, should all be confirmed and acknowledged by letter. A "thank you" follow-up letter is advised.

Transportation to and from the site must also be arranged. Whether the transportation is by chartered bus or cars it must be confirmed several weeks before the beginning of the workshop. In the week before the workshop, the site visit and the transportation should be confirmed.

Ten Weeks Before--Order Modules and Other Publications

Modules. Appendix C indicates where to order the written and audio-tutorial Land Application of Wastes modules. Each participant should be provided with a copy of the written modules. These are currently in press (October 1978) and should be available by early 1979. Be sure to include the cost of the two volumes of the written modules in the registration fee. Each participants should receive a personal set of the two volumes of the modules and the other publications.

Written modules should be provided for each participant and a set of A-T modules for every three to six participants.

A set of audio-tutorial modules for each slide-tape player is not necessary, however, there should be a set for every three to six participants. At certain times during the workshop almost all of the participants will want to study a particular A-T module at the same time. This is especially true of the Level I modules and "Nitrogen Considerations" and perhaps one or two others depending upon the particular concerns of the participants. More of these modules may be desirable, and we suggest one set for every three participants.

Publications. Appendix D indicates the publications that have been ordered for previous Land Application of Wastes workshops. A number of these publications are important as basic references for land treatment and may be given to each participant. Others would be of little interest to many of the participants. These latter publications may be ordered in lesser quantities to be used by those who are interested. Equipment manufacturers also provide publications concerning equipment that is available for land treatment. The workshop sponsors should indicate that they do not endorse any particular brand of equipment.

Publications to be used for reference may be obtained from the Government Printing Office and several equipment manufacturers. Quantities ordered should be commensurate with participant interest.

If the workshop is not government sponsored, the publications may have to be ordered from the Government Printing Office, in which case there may be a charge for each. In this case, the sponsors of the workshop may decide to give each participant a list of the publications which can be ordered. There then should be one or two copies of these publications available at the workshop for reference during the workshop. A number of the references are important in completing the design problem and there should be a copy for each group. These are the references concerning costs and are indicated in appendix D.

Nine and Eight Weeks Before--Order Materials for the Design Problems

By nine weeks before the workshop the design problems should have been developed for the workshop. At the workshop itself there should be as much reference material as possible concerning each design problem. If two groups are going to work on the same problem then there should be two sets of most of the reference material relating to each problem.

Reference material for the design problems include soil surveys, topographic maps, climatic information, and land use information.

Soil surveys. The basic source of site information and therefore the basic reference for the design problems, is the soil survey, developed by the Soil Conservation Service. Soil surveys should be available for the counties that may include possible sites for the design problem. As indicated in appendix E, these can be ordered from an SCS office in the design problem locality or from Washington. Soil surveys have not been conducted in every county in the United States. Where there is no published soil survey for a particular county, the soils department at the state college of agriculture may have an unpublished survey or comparable information. If, however, there is no soils information for a particular locality, then a design problem for that locality should not be used.

USGS topographic maps. Topographic maps are an essential tool for the design problem. The participants should have an adequate number of 7-½' maps for each problem. It is difficult to decide what an "adequate" number of maps is. There is an index of each state's available maps published by the United States Geological Survey. A store which sells USGS topographic maps can usually supply the index at no charge. Appendix E also indicates where to send for the topographic maps and indexes. This index can help the staff decide which maps to order. For a design problem involving a small flow, a minimum of four contiguous 7 1/2' maps are necessary to cover an adequate area. For larger flows, which would allow greater transmission costs, more maps would be necessary. Figure 4 indicates the index of a portion of California and the maps that were ordered for a particular design problem. The back of the index map indicates where the USGS maps can be obtained in each state. Shipment is usually faster is the maps can be ordered from a local source. Map stores in large cities or state capitals often can supply the maps for the whole state. As with the soil surveys, many areas of the country do not have published 7 1/2' maps. A 15' map does not provide the detail to be of much use for the design problem. If 7 1/2' maps are not available, consider not using that particular design problem.

Larger flows, and thus greater permissible transmission distances, require more 7 1/2' maps than smaller flows.

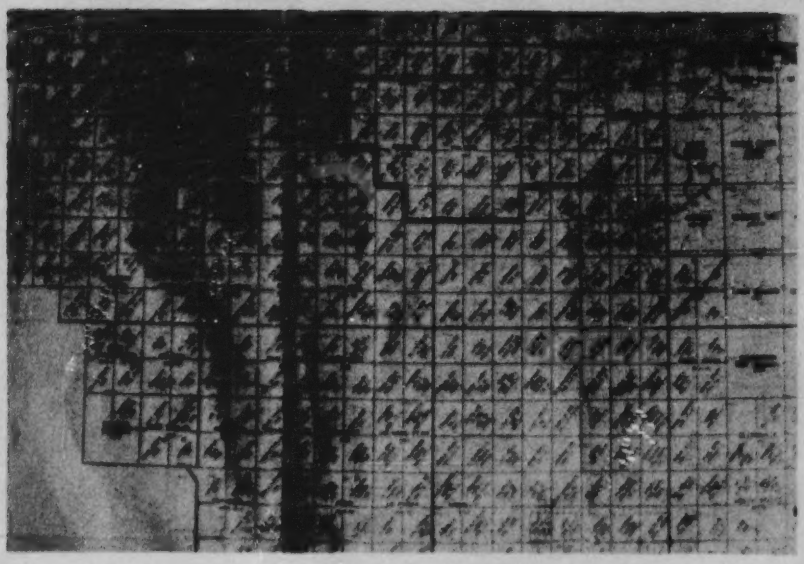

Fig. 4. Portion of the California topographic map index indicating maps chosen for a design problem in dark outline.

Climatic information. There is adequate climatic information for the entire country available from the National Oceanographic and Atmospheric Agency. Appendix E indicates the kind of information available and where to obtain it. The minimum information must indicate the monthly means, maximum, and minimum temperatures; the amounts and days of rain per month; the number of snow days and days with snow on the ground; the 25-year 24-hour rainfall; and evaporation and evapotranspiration on a monthly basis. This latter information is not absolutely necessary for the humid areas of the country.

Essential climatic information includes monthly temperature means and variability, precipitation, evaporation and evapotranspiration.

There are also computer programs available from the National Climatic Center (NCC) in Asheville, North Carolina, which utilizes the daily information from a weather station. These programs are described in detail in the Land Application of Wastes audio-tutorial module II-6, and to a lesser extent in the written module II-6, "Climate and Wastewater Storage." These computer programs detail and summarize much of the weather information necessary for a design of a land treatment site. For a workshop, the sponsors may wish to have one or more of these programs available for use by the participants. The programs cost approximately $100 per run (1978).

Much of the general information concerning climatic factors can be found in the Appendices of Written Module II-6, "Climate and Wastewater Storage" and is in the form of general maps which would be useful for at least the Level I design. This includes storage days, wind, temperature, hours of sunshine, humidity, precipitation, pan and lake evaporation, and evapotranspiration. It must be emphasized that this information is quite general and more specific data are useful for a good Level II design.

Land use. This is the kind of material that is the most difficult to obtain, for two reasons. First, many states do not have land use data developed on a statewide basis. Second, if a state does develop this information, the department that develops it may be difficult to locate. For example, New York State land use data are developed by the Land Use and Natural Resources section of the Natural Resources Department of the New York State College of Agriculture and Life Sciences, Cornell University. California land use information, however, is developed and distributed by the California Department of Water Resources. If land use summaries are available for a state, a city or regional planning department should be a good source. There are departments in state colleges of agriculture that also should know where to obtain any available data. If no land use information is available for a potential design problem, then the participants will have to make assumptions concerning land use. These assumptions can be made using the soil surveys and topographic maps as a data base.

Land use information is often difficult to obtain, but is important in that it minimizes the assumptions participants need to make.

Along with land use, it is a good idea to have realistic land prices for the design problem community. Agricultural land prices can vary from $100 per acre to over $7,000 per acre. A variation of only a few hundred dollars per acre can seriously change the cost effectiveness of a land treatment system. Local realtors in the design problem area usually can provide land costs for various kinds of land.

If some of the essential information is missing for a particular design, there are four options. One, the problem can be discarded. Two, the missing information can be fabricated by the workshop staff. This is very difficult to do realistically in most instances and is not recommended. It would take an inordinate amount of effort and time to make up a soil survey. Three, the problem can be kept and the

problem area changed to one where the information is available. This would mean changing the name of the community to one in a neighboring county or area for which there is enough information. Finally, the participants can work on the problem and make assumptions about the information that is missing. In an actual field situation, this is the way a consultant must work. The consultant, however, can and will visit an area before a Level II design is developed. In this way the missing information can be ascertained or at least approximated. It is difficult in a brief workshop to work without the necessary pieces of information.

Seven Weeks Before—Workshop Material

Figures 5 and 6 indicate the rooms arrangement for a workshop. Notice the amount of equipment that is in the rooms for the workgroups and for the group meetings. A checklist of material for a workshop is located in Appendix F.

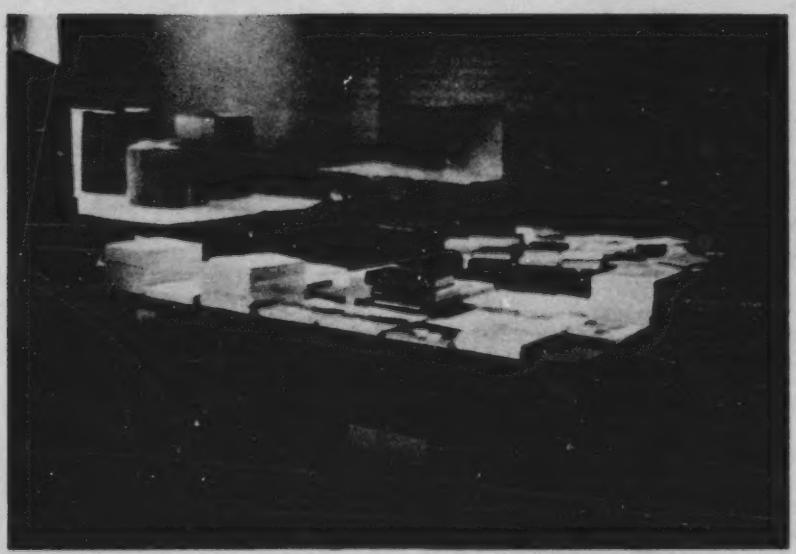

Fig. 5. Example of room arrangement for workgroups showing reference tables in foreground and two small-group work areas in the rear. Boxes on tables are filled with materials provided to participants.

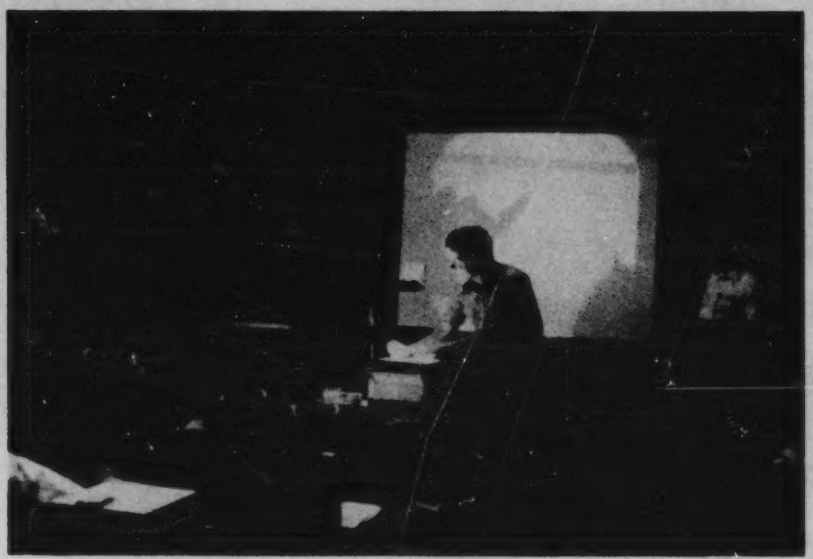

Fig. 6. Example of room arrangement for group meetings. Blackboards, screens, and projection facilities are provided. Seating (not shown) is adequate for all participants, staff, and visitors.

Tables for the workgroups should be between three and five feet wide to enable the participants to spread out the maps and still have work area. There must be a table for each workgroup, one for the speaker, one or two for the reference material, one for the staff, and enough to hold the slide-tape players. If carrel units are available for the slide-tape players, these may have their own tables built in. If the slide-tape players are to be put on tables without carrels, at least four linear feet of table space is recommended. Be sure there is room on the tables for the equipment plus the lesson box and a place for writing. Figure 7 shows an A-T set up from a recent workshop. Approximately three times as many chairs as participants and staff will be necessary for the workshop. There must be a chair for each slide-tape player as well as a few extra for visitors, around the coffee area, and so two people have the option of listening to an A-T module at the same time, as often happens.

In setting up for a workshop, consideration must be given to number and size of tables, chair arrangements, blackboards, and information packets for distribution to participants.

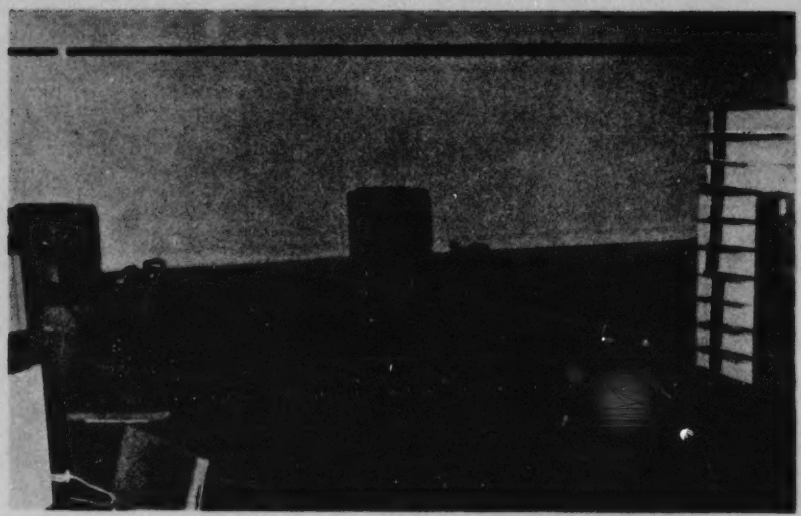

Fig. 7. Example of room arrangement for listening to A-T modules. Two Caramate units are shown for slide viewing. Stock of A-T lessons is on the table shown on the right.

Movable blackboards make good dividers between workgroups and are used for several different purposes. Some of the groups will hang their topographic maps on the blackboards, others will write their problem conclusions, and others will use the boards for explaining points to their group. At previous workshops we have found the blackboards to be indispensable pieces of equipment. An extra blackboard should also be available for the group discussions and for the distinguished speakers.

Each workgroup should be provided with a small packet of material. This includes pencils, acetate for developing overhead visuals for the presentation, colored felt pens for writing on the acetate, graph paper, and perhaps note pads. Acetate and writing equipment should also be provided for the speaker. The rest of the equipment listed in Appendix F should be self-explanatory.

Six Weeks Before--Design Problems

By six weeks before the workshop, most of the design problem material should have arrived. This is the time to review the design problems with the staff and assign particular design problems to each staff member. All of the staff should be familiar, to some extent, with all of the design problems. Each staff member should work on his design problem over the next week or so. Using the Level I modules, the limiting factor should be determined and a Level I design developed. This design should include a cost per thousand gallons for conventional as well as land treatment and the potential sites for land treatment. Table 3 illustrates a summary sheet that the workgroups can use for their Level I design during the workshop. This sheet can also be used by the staff in working on their design problems. The Level II design does not have to be worked out in detail at this point. Methods for minimizing the effect of the limiting factor should, however, be considered since many of the workgroups will be concentrating on this aspect during the Level II design effort. It is important to stress that the Level I and Level II designs should be done using the modules and reference material provided for the participants.

Design problems should be assigned to individual staff members who then review the problem and develop a Level I design in detail, and an outline for Level II.

The staff should get together again to go over the design problems and solutions that have been worked out. This will sensitize all of the staff to any peculiarities or difficulties with the design problems. If a design problem seems to be favoring conventional treatment, it still can be used for the workshop. Usually a sharp workgroup can modify the land treatment design, by using a combination of systems or other innovations, to make land treatment potentially feasible. Even if there is no hope for the land treatment system being cost effective, it still may be a good idea to see that land treatment is not the cost effective answer for all situations, and that the workshop staff realizes this fact. This also can lead to a discussion of cost effectiveness versus overall effectiveness and the ecological effects of land treatment as compared to other kinds of treatment. It is important for the staff to realize that the Water Quality Act of 1977 indicates that land treatment can be 115% of the cost of conventional treatment and still be considered cost effective. The workgroup using this design problem during the workshop can concentrate on developing the most cost effective land treatment system, while realizing that conventional treatment would probably be funded in an actual situation.

A final staff meeting to discuss the design problems is beneficial in that corrections and clarifications are made before the information is passed along to the participants.

Group Problem	Design Flow MGD	Conventional Treatment	Land Treatment	Limiting Parameter	Cost (¢/1000 gal)							Comments
					Conventional			Land				
					C	O&M	Total	C	O&M	Total	Income	

TABLE 3 - LEVEL I SUMMARY SHEET. To be filled out by each workgroup, and by all participants as workgroup reports are presented.

After the final staff meeting concerning the design problems, the problems can be given final corrections and clarifications and reproduced into a packet containing all of the design problems and basic information. This packet will be passed out to the workshop participants early in the first day of the workshop.

Five Weeks Before--Reference Books

The reference books for the workshop are indicated in appendix G. These books concern research and conference reports concerning land treatment or specific aspects of land treatment, background information on soils and soil elements, agriculture, and nutrient cycles. There are also standard sanitary engineering texts on the list, one of which should be available at the workshop. Many of these books were used as reference sources in the development of the instructional modules. These books can usually be found in an engineering library and an agricultural library. One copy of each title is adequate for the workshop.

Four Weeks Before--Arrangements for Arrival, Introductory Letter, Coffee and Tea

Arrangements for arrival. By the fourth week the sponsors should have firm commitments from participants. This is the time to either solidify or cancel the space reservations. Assuming that the workshop is proceeding, final preparations for the arrival of the participants should be made, such as arrangements for getting the participants to the notel/hotel if it is inconvenient to take public transportation from the airport. These arrangements should be sent to the participants at least one month before the beginning of the workshop so they can respond with their arrival times.

Introductory letter. Four weeks before the beginning of the workshop an introductory letter should be mailed to those who will be attending. This letter should give further details about the workshop--what the participants can expect, where and when the initial meeting will take place, and any equipment that the participants must bring (calculators, etc.). A sample introductory letter is indicated in appendix H.

Coffee and tea. It is useful to have coffee, tea, cold drinks, and possibly doughnuts available during the workshop hours. This can be ordered from a service or provided "in-house." The workshop budget will determine the extent to which these can be included. The workshop is intense and the participants appreciate the opportunity to relax and discuss issues over a cup of coffee. For forty participants and staff, about four gallons of coffee a day may be necessary. In warm weather, soft drinks and iced tea may be preferred.

Refreshments provide the opportunity for participants to relax between intensive work periods.

Three Weeks Before--Group Material, Introduction Preparation

The material for the workgroups, ordered in Week Seven, should be separated for the workgroups. At a staff meeting the introduction to the course should be planned. This introduction sets the tone for the workshop and, therefore, is one of the most important parts. One person should introduce the program and summarize the week and also indicate the reasons for holding the workshop. As many staff members as possible should participate in the introduction. This will give the participants the opportunity to become familiar with all of the staff. We have had one staff member give a general introduction and reasons for the program. Another staff member has talked about how to use the written modules and the A-T equipment. A third staff member introduced the design problems, describing each situation.

Multiple staff involvement is advantageous in the introduction which sets the tone for the rest of the workshop.

Two Weeks Before--Name Tags, Evaluation Forms, Public Hearing

Evaluation forms. Appendix I indicates an evaluation form that can be used for Land Application of Wastes workshops. The responses can be beneficial in helping the staff improve subsequent workshops. If the staff decides to design its own evaluation form there are several areas that should be evaluated. These include:

(1) The staff--

helpfulness
apparent knowledge of the subject matter

(2) The design problems--

clarity
usefulness in illustrating the land treatment concepts

(3) The speakers--

informative
helpful

(4) Workshop facilities--

location
comfort

(5) Accommodations

(6) Workshop introduction

(7) References and handouts--

adequacy
comprehensiveness

(8) General comments.

At the conclusion of the workshop, participants are asked to evaluate the staff, design problems, speakers, workshop facilities, accommodations, introduction, references and handouts. This is helpful in planning subsequent workshops.

It is most convenient for the participants to rank the questions on a scale or to indicate a positive or negative response. These ratings, however, mean different things to different people. It is advisable, therefore, to give space for comment after each question. In many cases, these comments will be very useful in planning future workshops.

Public hearing simulation. The public hearing can be one of the most beneficial parts of the workshop. It introduces a situation which may be the most difficult part in a facility plan for the professional to handle. It is, however, the most difficult part of the workshop to plan and carry off. Its success depends upon the planning that goes into it, the capability of the moderator, and the willingness of the participants to participate in the activity.

Appendix J gives the scenario that has been used at previous workshops. In brief, a town has to build a new treatment facility. Three potential locations have been chosen by the "out-of-town expert" and the public hearing is the first to discuss the three options and to consider the ranking of the three. The participants are assigned various roles in the community.

It is generally preferable to have one of the staff as the "out-of-town expert" who fields the questions, comments, and speeches of the members of the community. This person must be able to field questions rapidly and handle a very hectic situation with agility and a sense of humor.

The secret of a successful simulated public hearing is to have the participants feel comfortable speaking in front of the group. This feeling has to have developed during the previous days of the workshop through discussions and presentations. The roles that the staff believes are important ones should be given to those participants who have indicated their willingness to speak up during the workshop. Often these people are the more experienced ones in the group. The simulated public hearing, however, is of most benefit to those in the group who are new in the field. It is important for the experienced participants to realize that they are helping others know what it will be like when they attend their first public hearing. The simulated public hearing is introduced the day before it actually is to take place. A printed information packet is given to each participant. This packet describes the situation, contains a map of the community, and indicates the part that the person is to play. Hopefully, a few of the participants will prepare for their part in advance. A copy of the packet distributed for a public hearing simulation is given in appendix J.

A simulated public hearing enables the participants to experience and understand the various controversial viewpoints.

One Week Before--Individual Boxes, Set Up Rooms, Set Up A-T Modules

Individual boxes. If each participant is receiving a large amount of material to take home, the sponsors should distribute it before the workshop in individual boxes. Figure 8 shows the boxes from a recent workshop. The boxes should be mailable for those who do not wish to carry them. Mailing labels and shipping tags are necessary for this and can be provided on the last day of the workshop.

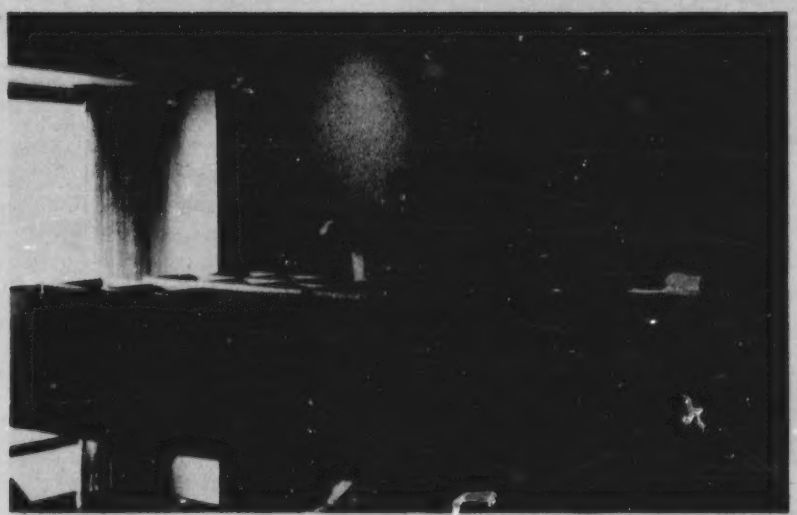

Fig. 8. Individual boxes used for distributing workshop materials. Packing materials into boxes should be done before the workshop begins.

Set up rooms. Each set of rooms is different. Figures 2 and 3 (pages 2 and 5) indicate the workroom set up for two different rooms. This set-up, starting from scratch will take three or four hours for one or two persons just for the furniture and equipment. If the reference material and boxes are to be distributed, the time will expand to a full day of work.

Just prior to the workshop, boxes should be distributed for workshop material, A-T modules should be stored for easy return, and furniture and equipment should be arranged in the rooms.

If the workshop is not in the same building as the sleeping facilities, the participants will also have to know how to get there. This can be done by letter, or a message at the housing desk, or by a brief get-together in the motel/hotel at the beginning of the workshop. A get-together the evening before the workshop, when most of the participants have arrived, can be useful to pass out name tags, a map, and some very general information about the city, when the workshop will officially begin, and to get the participants and staff to know each other. Since there are likely to be late arrivals, it is a good idea not to spend much time, if any, on the program details since it will have to be repeated.

Set up A-T modules. The A-T modules should be set up so that the participants can obtain them and return them easily and without staff assistance. Once a day during the workshop, a staff member should check the A-T modules to be sure they are in order. Figures 9 and 10 indicate the A-T module storage from Land Application of Wastes workshops.

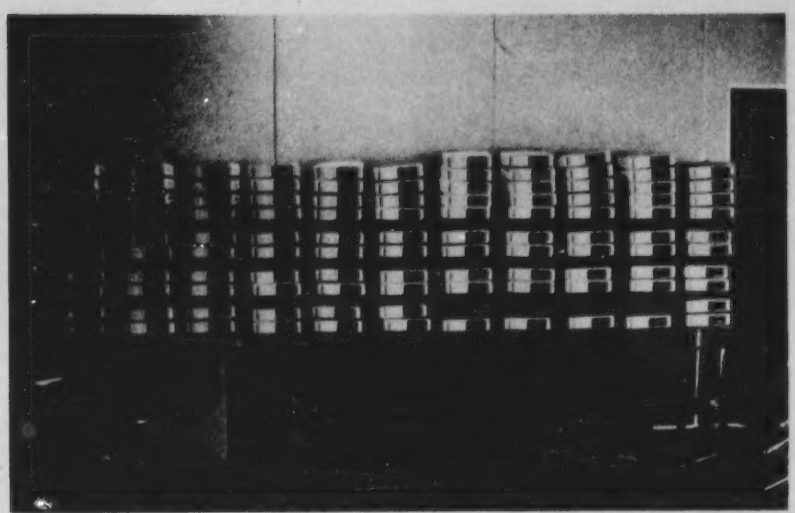

Fig. 9. Example of A-T module storage on tables in large workroom with other reference materials (not shown).

Fig. 10. Another example of A-T module storage in small workroom with Caramate units.

CONCLUSIONS

This module indicated a step-by-step schedule for preparing for a 5-day Land Application of Wastes workshop. If the schedule is followed, then the staff, participants, equipment, and material should all come together at the proper time, and with adequate preparation.

The next module, "Conducting A Workshop," indicates exactly what should happen during the workshop week, how to run discussion groups and public hearings, and troubleshooting. The final module in the Instructors' Package indicates the educational background for the learning package and the workshop, how to add to the package by developing additional modules, and variations in the use of the Land Application of Wastes Program.

Appendix A

DESIGN PROBLEM DEFINITIONS

GENERAL COMMENTS

An effort is made to use a specific design example of land treatment in this workshop as the focus of attention of a design team. Formation of a design team composed of 4 to 6 members and choosing a design example from those listed here are the first decisions which all individuals should make at the workshop.

Each design team should be prepared to make two presentations of the results of their investigations during the week. The first presentation will result from a preliminary feasibility investigation which is referred to as Level I Design and should be ready by Tuesday afternoon. The final presentation and the results of the Level II Design will be a more comprehensive consideration of alternatives and will be presented at the termination of the workshop. Some groups may give only one of the two presentations.

The examples given here represent a wide range of combinations of the application of land treatment technology. Resource materials which will be needed to examine the feasibility of land treatment of wastes have been obtained and are available. These include topographic maps, land use information, soil surveys, and climatic data.

Please note that although these examples represent real situations, some key parameters have been changed, so that the final analyses may not be applicable to the real world situation.

The following is a brief summary of typical design examples:

(1) Seneca Falls, New York

Medium-size residential community that presently has a modern and efficient wastewater treatment plant. It must be upgraded for nitrogen, phosphorus, and additional suspended solids removal.

(2) Santa Maria, California

A medium-size community and a large industry are considering building a joint treatment facility.

Example 1

PROBLEM DEFINITION FOR SENECA FALLS, NEW YORK
LOCATED IN SENECA COUNTY

Seneca Falls, New York (population 8,000) has a newly built (1970) wastewater treatment plant. It uses activated sludge secondary treatment. It is considered to be one of the best treatment facilities of its kind in New York State. However, to meet the requirements of a U.S.-Canadian treaty on the Great Lakes, the plant must upgrade the effluent quality from a secondary level to 1 mg/l P and 5 mg/l N. The table below shows concentrations of pollutants as they enter the treatment plant, after secondary treatment, and the concentrations required by the state.

WASTEWATER CHARACTERISTICS AND REQUIREMENTS
FOR SENECA FALLS, NEW YORK
(mg/l)

Pollutant	Raw Wastewater	Present Effluent	Required For Surface Discharge	Required For Groundwater Discharge
BOD	240	5	--	--
SS	250	5	--	--
N	40	20	5	10
P	10	6	1	3

The average daily flow is presently 1.5 MGD but is expected to increase to 3.5 MGD because of the increase in sewered population over its 20-year design life. This will be due to the addition of a neighboring town's system and a small population increase in Seneca Falls itself. The neighboring town produces a raw effluent very similar to Seneca Falls. There are no major industrial flows expected to be included in the influent to the treatment facility. The town is presently looking for a low cost tertiary treatment system to meet the nitrogen and phosphorus effluent requirements of the state.

Land application alternatives of the secondary treated effluent will be examined by calculating land areas which will satisfy the state's criteria and by locating sites within about 10 miles of Seneca Falls. Finally, the operation and maintenance costs as well as the capital costs of feasible land application systems will be compared to conventional alternatives which could be used to meet the state's criteria.

CLIMATIC DATA FOR GENEVA, NEW YORK
(GENEVA & SENECA FALLS)
30 YEARS OF RECORD

Date	Mean Temperature (°F)	Mean Precipitation (in)
January	24.3	2.02
February	25.1	2.09
March	33.7	2.64
April	46.5	2.88
May	56.5	3.02
June	66.7	3.10
July	71.4	3.06
August	69.5	2.82
September	62.6	2.59
October	52.3	2.97
November	41.0	2.78
December	28.4	2.35
Annual	48.2	32.32

Example 2

PROBLEM DEFINITION FOR SANTA MARIA, CALIFORNIA

This town, located in southern California (in the Northern Santa Barbara Area soil map area), is characteristic of the picturesque towns located in the arid part of California just north of Los Angeles. The projected design flow for the year 1998 is 8 MGD. Presently, the flow from a well established sugar manufacturing facility is 8 MGD, and it is predicted that this will increase to 10 MGD by 1998. If it is assumed that the effluent quality must meet the following standards, determine the most cost effective treatment alternative for this combined wastewater.

MAJOR CHARACTERISTICS OF SUGAR PROCESSING WASTEWATER
(mg/l)

BOD_5	600
COD	800
N	20
P	2
TSS	400
TVS	200
pH	6.6
Temperature	40°C

REQUIRED EFFLUENT STANDARDS FOR SURFACE DISCHARGE
(mg/l)

BOD_5	5
SS	5
N	5
P	1

For groundwater discharge, nitrogen levels from a land treatment site should meet drinking water standards of 10 mg/l NO_3-N. All other parameters as shown for surface discharge.

CLIMATIC DATA FOR SANTA MARIA, CALIFORNIA
30 YEARS OF RECORD

Date	Normal Daily Means Temperature (°F)	Normal Precipitation (in)
January	50.5	2.25
February	52.0	2.40
March	52.8	1.98
April	54.9	1.31
May	57.1	.19
June	59.6	.04
July	62.1	.03
August	62.3	.02
September	62.6	.10
October	60.4	.52
November	56.1	1.36
December	51.8	2.05
Annual	56.9	12.25

Appendix B

AUDIO-VISUAL EQUIPMENT

1. Slide-cassette tape players or slide projectors and audio-tape cassette players.* One for every two participants is recommended.
2. Earphones for slide-cassette tape players
3. Extra bulbs for slide-cassette tape players
4. 16 mm sound projector
5. Slide projector
6. Cassette recorder
7. Patchcord to have slide projector cued to cassette recorder
8. Remote control slide change mechanism for speaker
9. Overhead projector (two or three, if available)
10. Acetate (transparencies) for overhead projector (10-15 sheets per workgroup)
11. Pens or pencils for writing on acetate
12. Extension cords

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*Both Singer Caramate units and Kodak Audioviewer units have been successfully used. Newer models of either of these machines have been satisfactory, but older models frequently malfunction. Also, some older model Caramate units respond to tone signals at a different frequency for advancing the slides and slides must be advanced manually. If they are available, any 35 mm slide projector and cassette tape player can be used, but slides may have to be advanced manually.

Appendix C

WHERE TO ORDER WRITTEN AND AUDIO-TUTORIAL MODULES

Written Modules

Currently in press and will be available in early 1979. In order to be put on a mailing list notifying you when the book is ready for distribution, write to:

Ms. Irene Hoffman
Van Nostrand-Reinhold Company
135 West 50th Street
New York, New York 10020

Audio-Tutorial Modules

Available currently from Cornell University. Sixteen modules including 869 slides in 16 carousel trays, 16 cassette tapes, and 16 lesson packages containing scripts and supplementary material (224 printed pages)

Write to:

Instructional Materials Service
3 Stone Hall
Cornell University
Ithaca, New York 14853

Appendix D

PUBLICATIONS WHICH MAY BE ORDERED FOR WORKSHOP

EPA Publications

Write to: Publications Department
U.S. EPA
E.R.I.C.
Technology Transfer
Cincinnati, OH 45268

1. A guide to the selection of cost effective wastewater treatment. EPA 430/9-75-002.**
2. Application of sewage sludge to cropland. EPA 430/9-76-013. MCD-33.
3. Cost effective comparison of land application and advanced waste treatment. EPA 430/9-75-003.[a],**
4. Costs of wastewater treatment by land application. EPA 430/9-75-003.[b],**
5. Evaluation of land application systems. EPA 430/9-75-001.
6. Land application of sewage effluent and sludges: Selected abstracts. EPA 660/2-74-042.
7. Land treatment of municipal wastewater effluent--Case histories. EPA Technology Transfer Seminar Publication, January 1976.
8. Land treatment of municipal wastewater effluents--Design factors I. EPA Technology Transfer Seminar Publication, January 1976.
9. Land treatment of municipal wastewater effluents--Design factors II. EPA Technology Transfer Seminar Publication, January 1976.
10. Metcalf and Eddy, Inc. 1977. Process design manual for land treatment of municipal wastewater. U.S. EPA, U.S. Army Corps of Engineers, and U.S. Department of Agriculture. EPA 625/1-77-008. ERIC-Technol. Transfer. Cincinnati, Ohio.
11. Survey of facilities using land application of wastewater. EPA 430/9-73-006.
12. Wastewater treatment and reuse by land application--Volume I. EPA 660/2-73-006a.
13. Wastewater treatment and reuse by land application--Volume II. EPA 660/2-73-006b.
14. The Werribee farm system. Land application of wastewater in Australia, May 1975. (Seabrook, B.L.).

** Important for completion of the design problem.

[a] Pound, Crites and Smith.

[b] Pound, Crites and Griffes.

U.S. Army Corps of Engineers Publications

Write to: Publications Department
U.S. Army Corps of Engineers
DAEN (HQDA)
1000 Independence Avenue
Washington, D.C. 20314

1. Overland flow treatment of wastewater. 1974. Miscellaneous Paper Y-74-3. Environmental Effects Laboratory.

2. Wastewater treatment on soils of low permeability. Miscellaneous Paper Y-74-2. (Hoeppel et al.).

3. Selected chemical characteristics of soils, forages, and drainage water from the sewage farm serving Melbourne, Australia, January 1974. (Johnson, R.D. et al.).

Cold Regions Research and Engineering Laboratory (CRREL) Publications

Write to: Publications Department
Cold Regions Research and
Engineering Laboratory
U.S. Army Corps of Engineers
Hanover, NH 03755

1. The effects of wastewater application on the growth and chemical composition of forages. Report 76-39.

2. Evaluation of existing systems for land treatment of wastewater at Manteca, California and Quincy, Washington. Report 77-24.

3. Land treatment of wastewater at West Dover, Vermont. SR 77-33.

4. The land treatment module of CAPDET, December 7-8, 1977. (Merry, C.J., and Spaine, P.A.). (handout)

5. The land treatment module of the CAPDET program, December 7-8, 1977. (Merry, C.J., and Spaine, P.A.). (paper)

6. Rapid infiltration of primary sewage effluent at Fort Devens, Massachusetts. SR 76-48. (Satterwhite, M.B. et al.).

7. Treatment of primary sewage effluents by rapid infiltration. Report 76-49. (Satterwhite, M.B. et al.).

8. Wastewater management by disposal on the land. SR 171. (Reed, S.).

9. Wastewater renovation by a prototype slow infiltration land treatment system. Report 76-19. (Iskandar, I.K. et al.).

U.S. Army Environmental Hygiene Agency Publications

Write to: Publications Department
U.S. Army Environmental Hygiene Agency
Aberdeen Proving Ground, MD 21010

1. Monitoring of wastewater land disposal sites. Water Quality Special Study No. 24-048-73/76, October 1975.

Appendix E

SOURCES OF INFORMATION

Land Use

Local, state, and/or regional planning agencies (see page 19 of this module).

Topographic Information

For states east of the Mississippi:

Branch of Distribution
U.S. Geological Survey
1200 Eads Street
Arlington, Virginia 22202

For states west of the Mississippi:

Branch of Distribution
U.S. Geological Survey
Federal Center
Denver, Colorado 80225

Soil, Geologic and Drainage Information

Soil Survey - local or county Soil Conservation Service Office; County Agents

U.S. Geological Surveys

State Geological Surveys

State Mining Industries Records and Reports

State Universities

U.S. Army Corps of Engineers District Offices

Waterwell Drillers Records

Climatic Data

For monthly summaries of climatic data (for a given area) for local climatological data and climatic summary of the United States:

National Oceanic and Atmospheric Administration
Environmental Data Service
National Climatic Center
Asheville, North Carolina 28801

For storage requirement computations:

Statistical Climatology Branch
National Climatic Center
Asheville, North Carolina 28801

Aerial Photographs

This office can provide "Status of Aerial Photography in the U.S." which is a key, by county, to the photography that has been done by or for the Agricultural Stabilization and Conservation Service, Soil Conservation Service, Forest Service, Geological Survey, Corps of Engineers, Air Force, Coast and Geodetic Survey, and commercial firms:

Map Information Office
U.S. Department of the Interior
Geological Survey
Washington, D. C. 20240

Other Information that May Be Helpful

Summary of Conservation Need Inventory - local Soil Conservation Service Office (for county, multi-county area, a state, etc.).

Appendix F

CHECKLIST OF MATERIAL NEEDED FOR WORKSHOP

1. Meeting room

2. Speaker's platform--

   (a) podium
   (b) microphone
   (c) table
   (d) pointer for use with slides

3. Furniture

   (a) tables for slide-cassette tape players (at least 3 linear feet per slide-tape player)
   (b) tables for workgroups (5' x 5' table area for each group)
   (c) tables for reference materials (two to four)
   (d) chairs (1 1/2 to 2 per participant)
   (e) room dividers (see room diagrams)
   (f) movable blackboards (see room diagrams)
   (g) blackboard for speaker
   (h) colored chalk for speaker

4. Miscellaneous

   (a) graph paper (one pad per workgroup)
   (b) storage space for A-T modules (15 to 20 linear feet of tables, shelves, cabinets, etc.)
   (c) extension cords
   (d) coffee, tea, and donuts
   (e) transportation
   (f) packing tape (3 feet per participant)
   (g) magic markers
   (h) nametags
   (i) mailing labels
   (j) rolls of twine (two)
   (k) boxes for distribution of individual packets of material (one per participant)
   (l) pens, pencils, paper
   (m) list of nearby eating facilities

Appendix G

REFERENCE BOOKS

1. Battelle Northwest Labs. 1974. Evaluation of municipal sewage treatment alternatives. Prepared for the Council on Environmental Quality. EQC 316.

2. Brady, N.C. 1974. The nature and properties of soils. New York: Macmillan Co. 639 pp.

*3. Clark, J.W., and Viessman, W., Jr. 1969. Water supply and pollution control. International Textbook Co., Scranton, PA. 575 pp.

4. Elliott, L.F., and Stevenson, F.J., eds. 1977. Soils for management of organic wastes and wastewaters. ASA, CSSA, SSSA. 650 pp.

*5. Joint Committee of the American Society of Civil Engineers and the Water Pollution Control Federation. 1959. Sewage treatment plant design. 375 pp.

6. Loehr, R.C. 1974. Agricultural waste management--Problems, processes, and approaches. New York: Academic Press. 576 pp.

7. Loehr, R.C. 1977. Land as a waste management alternative. Proceedings of the 1976 Cornell Agricultural Waste Management Conference, Ann Arbor Science Publishers, Inc. 811 pp.

*8. Metcalf and Eddy, Inc. 1972. Wastewater engineering: Collection, treatment, disposal. New York: McGraw-Hill Book Co.

9. New York State Office of Planning Services. 1974. LUNR classification manual--Land use and natural resource inventory of New York State. 23 pp.[a]

10. Norum, E., ed. 1975. Wastewater resource manual. Sprinkler Irrigation Association, Silver Spring, MA.

11. Sanks, R., and Asano, T., eds. 1976. Land treatment and disposal of municipal and industrial wastewater. Ann Arbor Science Publishers, Inc. 310 pp.

12. Soil Conservation Society of America. 1976. Land application of waste materials. Ankeny, Iowa. 313 pp.

*13. U.S. EPA, U.S. Army Corps of Engineers, and USDA. 1977. Process design manual for land treatment of municipal wastewater. EPA 625/1-77-008.

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*Examples of standard sanitary engineering texts or design manuals which are valuable in comparing land treatment and conventional options.

[a]If New York State design examples are used. If examples are used from other states, an effort should be made to obtain land use information and interpretations from the appropriate state agency. There is no standard format for such information.

Appendix H

INTRODUCTORY LETTER

Dear Participant:

This letter provides a brief description of the workshop which you will be attending at the University of Maryland from June 19 to 23, 1978. It is hoped that advance familiarity with the Program will minimize the orientation necessary at the beginning of the workshop.

This Program makes use of educational techniques which may be new to you. As a result, the workshop may be unlike those which you may have attended in the past in several respects:

- Emphasis in on the fundamental principles of the land application process
- There will be relatively few lectures and most of the learning will take place in guided self-study, workgroups of three to five participants, and staff tutoring
- This is not a "design workshop" in the sense of teaching a "workbook" approach to design of land application systems. Individuals will have to apply the fundamentals to site specific situations
- Hardware and equipment details are not covered
- Individual learning is stressed
- Each person will receive 22 written "modules" covering various topics relating to land application, along with supporting materials as a permanent reference
- Each person will have access during the week to audio-tutorial lessons and equipment for listening and viewing
- No one is expected to cover all of the material within the week of the workshop
- Design problems are used, but as an aid to learning fundamental concepts by applying them, not as the primary focus of the workshop
- Participants may use extra time (i.e., evening hours) for individual or group use of the program materials.

Each of the following learning techniques is used in this Program:

- Self-paced study of audio-tutorial (slide and cassette tape) lessons
- Small-group work on real-world design problems (bring a calculator, if possible)
- Limited use of lectures by program staff
- Distinguished guest speakers
- Demonstrations, such as the Corps of Engineers CAPDET computer model
- Informal "case history" presentation
- Field trip
- Presentations and discussion by participants of design problem solutions.

Obviously, in order to cover all of the activities mentioned, and as much of the material as possible, within four and one-half days requires adherence to a schedule. This will be handed out and discussed in detail in our orientation session on Monday, June 19, Room C of the Adult Education Center, beginning at 8:30 a.m. It should be emphasized that the first two hours on Monday morning will be devoted to detailed orientation, which will include presentation of Program objectives, discussion of the schedule, description of the written and audio-visual materials with which you will be working, introduction to the design problems, description of the physical facilities, and other concerns of the group.

Appendix I

WORKSHOP EVALUATION

In order to assess the effectiveness of this workshop as an educational effort, we would appreciate your frank comments on each of the following:

I. INDIVIDUALIZED INSTRUCTION

A. Printed Study Modules

1. Technical quality and scope--

2. Educational value--

3. Future uses or value--

B. Audio-Tutorial Study Units

1. Technical quality--

2. Educational value--

3. Possible value in future self-study--

C. Small Workgroups

1. Educational value--

2. Social or personal value--

3. Major problems or successes--

D. Staff Tutorial Assistance

1. Availability--

2. General quality and helpfulness--

3. Advantages and/or disadvantages--

II. STAFF AND GUEST LECTURES

A. Effectiveness as an Educational Component

B. Value of Presentations

1. (Name)--

2. (Name)--

3. (Name)--

III. DESIGN PROBLEMS

A. Effectiveness as a Learning Vehicle

B. Successes and/or Frustrations

C. Adequacy of Supporting Documents

D. Value of Presentations of Other Workgroups

IV. PUBLIC HEARING

A. Effectiveness as a Learning Tool

B. Overall Value/Interest

C. Suggestions for Improvement

V. VALUE/ADEQUACY OF OTHER COMPONENTS

A. References

B. Coffee Hours

C. Field Trip

D. Room Accommodations

E. Pre-Program Announcements

F. Orientation Session

G. Eating Facilities

H. Take-Home Materials

I. Opportunities for Meeting New Professionals

VI. GENERAL RATING OF WORKSHOP

VII. GENERAL COMMENTS ON WORKSHOP

VIII. PROFESSIONAL INTEREST _____

Years of Experience _____

Previous training in Land Application Systems--

Future interests in Land Application technology--

NAME _____ (optional)

Appendix J

PUBLIC HEARING SIMULATION

Introduction

Perhaps the greatest obstacle which designers of land application systems must overcome is public fear of this waste management alternative. If a community is unsure of what land application entails it may attempt to halt such a project. The concerns which a community is likely to express when introduced to the land application alternative must be understood and information provided to put those concerns in perspective.

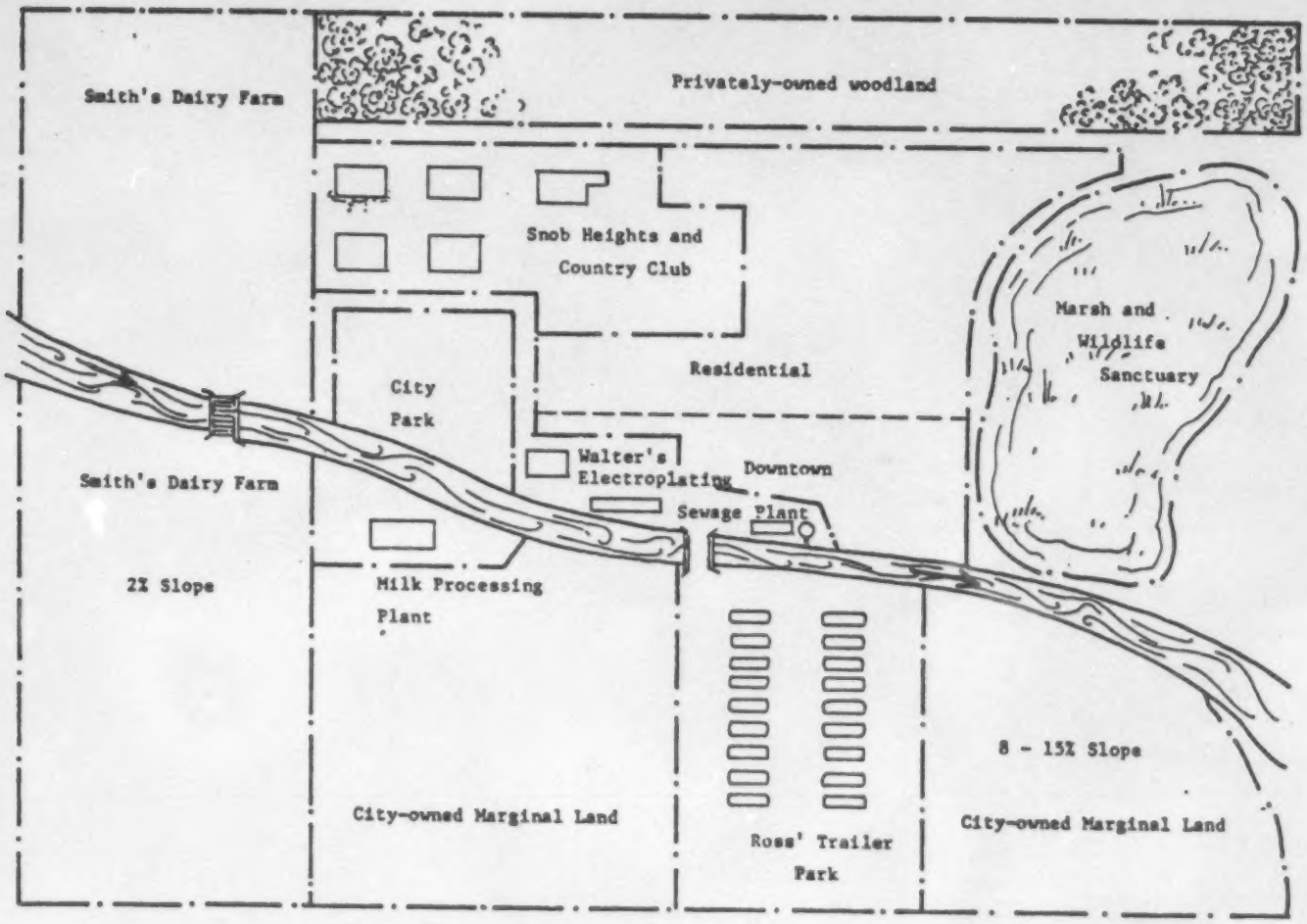
Concerns usually surface at a preliminary public hearing when a consulting engineer first describes the alternatives available to the community. In most cases, there will have been some news coverage of the engineer's findings prior to the hearing. People will come to the hearing with more or less knowledge. Their questions will range from direct technical questions to emotionally-based charges of neglecting the health and welfare of the community.

In order to illustrate what might transpire at a preliminary public hearing on land application as a waste management alternative, we have included a role playing situation in this workshop. The participants will actually take on the roles of various members of a hypothetical community. The description of the community and the current situation will be presented in the following paragraphs.

The Community

Thistown, USA, is a small community built on either side of the Bubbling Waters River. The town currently has a sewered population of 7,500 people and is expected to expand to 8,500 by the year 2000. A map of Thistown is shown on the following page.

The main industry in the town, employing over 200 people, is an electroplating facility. Many of the workers in this facility live in Ross's Trailer Park, as well as in the residential area. The milk processing plant is another major employer and is part of a farm cooperative. Smith's dairy farm is located on the edge of town. The farm has been in the same family for over 150 years. The town has grown up around the farm. Mr. Smith sold the land where Snob Hill is located and donated the park to the town. Like most small towns, the residents are active hunters and fishermen. The marsh and wildlife area is currently used by sportsmen for duck hunting, by children for nature study, and by members of the Audubon Society for bird watching.



Thistown, U.S.A. A representative community for a role-playing situation focused on public concerns about land application systems.

The Situation

The sewage treatment plant currently discharges primary treated effluent into the river and is adequate for the current population. It must be replaced or upgraded to meet 1985 treatment standards.

An ad hoc committee was appointed by the mayor to look into the various alternatives for meeting the 1985 standards. The committee, in turn, hired an outside expert, a man respected in the field, as a consultant. Although rumors have been circulating and there has been a lot of talk about land treatment, this is the first actual public hearing. The outside expert is going to present various alternatives and rank these alternatives.

The Characters and Their Concerns (Roles assigned to workshop participants one day in advance)

Mr. Smith: Owns a dairy farm with about 1,000 acres of pasture and cropland west of the town. His concerns include:
(a) effect a land application site would have on land values in the community
(b) changes in zoning that may be brought about by a land application system
(c) how crops grown on land application site would compete with his crops at the marketplace.

Mr. Black: Head of farm cooperative, manager of milk processing plant. His concerns include:
(a) cost of land application systems
(b) ability of land application systems to handle milk wastes (high BOD_5)
(c) possible requirement for extensive pre-treatment of wastes from his plant before they are acceptable for land application.

Mr. Walters: President of electroplating company. Employs 200 people of the town. His concerns include:
(a) effluent limitations on metals which would be required if land application were initiated
(b) cost of land application; additional costs for pre-treatment of metal wastes.

Mr. Jones: President of Local 123, Electroplaters of America. His concerns include:
(a) if Walters is required to upgrade his plant, the factory may be forced to move out of this community, putting 200 of his workers out of work. Even if the factory does not move out, he is afraid that upgrading the plant may mean that his workers will not get a good pay package next year.

Mr. Richards:	Mayor of town. His concerns include: (a) odor and appearance of the land application site may detract from this community.
Mrs. Marcy:	President of local Audubon Club, overseer of marsh and wildlife sanctuary. Her concerns include: (a) a land application system may threaten the wildlife sanctuary which she spent ten years establishing (b) the land application system may increase disease problems among the area's wildlife (c) effect of the system on remaining open space in the community.
Mrs. Bloom:	Housewife, mother of three school-age children, member of the League of Women Voters. Her concerns include: (a) odor and appearance of the site (b) accessibility of the site to children (c) safety of the system in terms of controlling entry of heavy metals and pathogens into the environment.
Mr. Ross:	Owns (but does not live in) trailer park on southern shore of river. Built on marginal land as a tax loss several years ago. One hundred to 150 live in the trailer park. His concerns include: (a) the best site for a land application system may be on the land he owns where his trailer park is built. He would sell, but only at the "right" price.
Ms. Prior:	Social worker, founder and president of local tenants union and welfare rights group. Her concerns include: (a) is afraid that poorer people may be forced from their homes without sufficient payment to make way for a land application site (b) is aware of Mr. Ross's position, and is afraid that he will sell, leaving his tenants, mainly welfare recipients, without housing.
Mr. Prampton, P.E.:	Consulting engineer, Problem Solvers, Inc.
Mr. Noyes:	Resident of Ross's trailer park. Avid hunter and fisherman. His concerns include: (a) the effect of land application on hunting and fishing (b) effect of land application on the environment of the trailer park (c) access to hunting and fishing land.

Dr. Fisher: Out-of-town expert hired by the Audubon Club. Consultant recommended by the Grand Teton Club. His concerns include:
(a) basic concerns with the welfare of the birds, animals, and fish
(b) does not like fishing and hunting
(c) believes that man is on the road to destruction because of improper intrusion into natural areas.

Mr. Birch: Owner of the woodland north of town. His concerns include:
(a) lowered property values for his woodland, unless it is the location of the site
(b) lives out of town and is anxious to sell his land, at a profit, to the town.

Mr. Rockcastle: President of Homeowner's Association of Snob Hill. His concerns include:
(a) effect of land treatment site on his property values
(b) presence of odors and pathogens
(c) aesthetic worries.

Mr. Sheppard: President of the Golf Club and chairperson of the Chamber of Commerce. His concerns include:
(a) effect of land treatment on taxes
(b) effect of land treatment on business
(c) effect of treatment on the golf course and its annual professional tournament.

Mr. Goodguy: Member of ad hoc committee. His concerns include:
(a) wants very much to see the best land at the lowest cost for the town
(b) has been working with the consultant for several months as a member of the committee. Has visited several land treatment sites.

Ms. Bud: Member of ad hoc committee. Her concerns include:
(a) wants very much to see the best land at the lowest cost for the town
(b) has been working with the consultant for several months as a member of the committee. Has visited several land treatment sites.

Mr. Haith: Member of ad hoc committee. His concerns include:
(a) wants very much to see the best land at the lowest cost for the town
(b) has been working with the consultant for several months as a member of the committee. Has visited several land treatment sites.

****
* INSTRUCTOR'S PROGRAM *
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Module B

CONDUCTING A WORKSHOP

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OBJECTIVES

Upon completion of this module, the reader should be able to:

(1) Indicate the different kinds of activities that take place during a Land Application of Wastes workshop and their contribution to an understanding of basic principles.

(2) Explain the need for careful scheduling and pacing of each activity in the workshop.

(3) Select options for dividing participants into workgroups and getting the workgroups started.

(4) Identify problems and solutions for workgroups that: proceed too fast or too slow; have reticent members; have dominating individuals.

(5) Indicate the reasons for balancing schedules of small-group and large-group activity.

(6) Recognize planning needs for a successful field trip.

(7) Identify key factors important in a successful public hearing.

CONDUCTING A WORKSHOP

INTRODUCTION AND SCHEDULE

A workshop is only as good as the planning that goes into it. Module A in this series detailed a procedure for planning a Land Application of Wastes workshop. This module takes the planning a step further and allows the staff to prepare for conduct of the workshop and for contingencies that can happen during a workshop. Problems can and will occur, no matter how much planning goes into the workshop and how skillful the staff. A well-prepared staff, however, can cope with the situations that may arise. Problems that may occur will not affect the smooth operation of the workshop if the staff maintains its sense of humor and confidence. It takes a mature individual to conduct a workshop that involves so many different activities. That individual must realize and have confidence in what he knows and not be afraid to admit that there are things he does not know. A good workshop will be a learning experience for all involved--the staff as well as the participants--as long as the staff realizes that they have much to learn.

A good workshop will be a learning experience for all involved--the staff as well as the participants--as long as the staff realizes that they have much to learn.

Table 1 indicates a typical schedule for a Land Application of Wastes workshop. There is so much to be done during the week that it is quite important to stick to a schedule as closely as possible. There never seems to be enough time to complete each part of the workshop, but the groups have always managed to do an excellent job when the time limit was up. Sticking to a rushed schedule ensures that a workgroup will not go into too much detail on any one part of the workshop activities. Although the workshop schedule in Table 1 lists many activities, they can be classified under a few headings: introductory portion, small-group work and discussions, lectures, and a simulated public hearing. If the schedule in Table 1 was reworked to reflect these activities, it would look like Table 2.

Keeping to a schedule is important so that all the activities (introductory portion, small-group work and discussions, large-group activities, and a simulated public hearing) are given adequate attention.

The remainder of this module discusses each of the kinds of activities and suggests ways of making the activities as beneficial for the participants and staff as possible. If a workshop is to be shorter than the standard four and one-half days, the number of activities may be reduced but the variety of activities will remain about the same. Module C in the Instructors' Program suggests some ways of modifying the basic program.

TABLE 1

SCHEDULE FOR A TYPICAL WORKSHOP

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 a.m.	Registration, Welcome, Introduction to Program	Level I Design Procedure- Limiting Design Factors	Introduction to Level II	Group Discussion if needed- alternative systems	Prepare Level II Design
9:00	Written & A-T Modules, Design Problems	XXXXXXXXXX	Level II XXXXXXXXXX	XXXXXXXXXX	Presentation of Level II Designs
9.30		XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	
10:00	Coffee	Coffee	Coffee	Coffee	Coffee
10:30	Level I XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	Discussion & Evaluation
11:00	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	
11:30	XXXXXXXXXX	Complete Level I Topics	Discussion- Pathogens & toxic elements (or nitrogen)	XXXXXXXXXX	
NOON	Lunch	Lunch	Lunch	Lunch	Adjournment
1:00 p.m.	Speaker	Speaker	XXXXXXXXXX	Speaker	
2:00	XXXXXXXXXX	Prepare Level I Design	XXXXXXXXXX	XXXXXXXXXX	
3:00	XXXXXXXXXX	Presentations of Level I Designs	Field Trip (optional)	XXXXXXXXXX	
4:00	Design Problem Definition & Review of Format & Early Problems	Discussion of cost effectiveness & pollution control efficiency		Level II Modules, Complete Public Hearing	
5:00					
7:30	Evening Program				

XXXXXXXXXX - denotes time set aside for individualized study with tapes, slides, written material and other prepared material. Individual course instruction and tutoring are also available at these times.

TABLE 2

SCHEDULE FOR A WORKSHOP CATEGORIZED BY KIND OF ACTIVITY
(adapted from Table 1)

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 a.m.	Introductory Activity	Large-group discussions (C)	Introductory Activity	C	Small-group work, discussions, & independent study (A)
9:00		A	A	A	C
9:30		A	A	A	
10:00	Coffee	Coffee	Coffee	Coffee	Coffee
10:30	A	A	A	A	C
11:00	A	A	A	A	
11:30	A	A	C	A	
NOON	Lunch	Lunch	Lunch	Lunch	Adjournment
1:00 p.m.	Lectures (B)	B	A	B	
2:00	A	A	A	A	
3:00	A	C	Field Trip*	A	
4:00	C	C		Simulated Public Hearing	
5:00					
7:30	A or C	A or C	A or C	A	

*Optional.

KEY: A = Small-group work, discussions, and independent study.
B = Lectures.
C = Large-group discussions.

INTRODUCTORY ACTIVITIES

The introductory portion of the workshop is most important in assuring a successful program. As indicated in Module A of this Instructors' Program, each member of the staff should have responsibility for a portion of the introduction.

The first staff member to speak, usually the senior member, not only should welcome the participants to the program and indicate a general rationale for holding the workshop, but also ought to be very specific about the objectives for the workshop. These objectives must be stated in terms with which the participants can deal during the workshop. Thus, an objective, to learn about land treatment, is too vague to help the participant focus his efforts.

The introductory speaker presents the objectives which will guide the participants during the workshop.

More specifically, the program will enable the participant to:

(a) compare alternative treatment technologies for pollution control and cost effectiveness

(b) develop cost estimates

(c) develop preliminary designs of land treatment sites

(d) locate potential land treatment sites for specific applications

(e) designate the limiting parameter in a waste treatment problem

(f) understand the fundamental principles of land treatment.

All of these objectives, except the last one, are specific and can be used by the participant to help guide his efforts during the workshop. There may be other objectives for other workshops and other situations. In all cases, the participant should be informed of the specific objectives during the workshop introduction.

The organization of the workshop should also be detailed in the introductory program. This includes the introduction to the modules and their use. Information for this part of the introduction can be gathered in Module C, which discusses the modular approach to learning and its advantages. The organization of the workshop is summarized in Table 3. It is important to emphasize that it is not necessary or possible for the participants to have studied each module by the end of the workshop. All of the participants will cover the first seven modules, and each workgroup collectively will cover all twenty-two

The initial presentation also includes an introduction to the modules, an A-T demonstration, and a discussion of the design problems.

TABLE 3

ORGANIZATION OF A LAND APPLICATION OF WASTES WORKSHOP*

Written and A-T Modules-- provide fundamental principles of land treatment. The written and A-T modules contain approximately the same information. It is not expected that the participants will complete all of the modules during the workshop. The modules are used individually and in any order, but Level I should be used before Level II.

Workgroups-- The participants are divided into groups of three to five members. Each group works on a specific design problem. All of the members of the workgroups are expected to study the Level I modules and develop a preliminary design to compare land and conventional treatment for the design problem. The labor is divided on the detailed or Level II design, with each member of the group studying a particular aspect of the design and reporting it to his workgroup.

Design Problems-- include a description of a community, industry, or other situation that involves a waste treatment problem. The design problem is used in a workshop to help the participant learn the fundamental principles and their application in a real situation. Solving the design problem is not the chief objective of the workshop. The design problem serves as a vehicle to learn fundamental principles and to understand their application to real-life situations.

Group Discussions-- are held from time to time during the workshop to talk about important aspects of land treatment, or to discuss general problems that arise.

Distinguished Speakers-- are invited to lecture on particular aspects of land treatment. These speakers are usually experts in an area of land treatment and can add to and update the information in the modules.

Design Presentations-- are developed by the workgroups and indicate the conclusions they have reached concerning the design problems and their reasoning behind the conclusions. These presentations should compare land treatment and conventional treatment for costs and effectiveness as well as reflect the fundamental principles indicated in the modules.

Public Hearing Simulation-- is an important part of the workshop where the participants are assigned to play the parts of members of a community that need a new treatment facility. Public hearings destroy more land treatment facilities than lack of feasibility. This activity should help those who have not attended a public hearing to prepare for one.

Tutors or Staff-- provide sources of information concerning soils, weather, crops, and land use. They can also direct the workgroups to different modules for further information. A particular tutor will assist each workgroup.

*This information should be reviewed in the Introductory session.

modules, by assigning several of them to each individual participant in the group. However, the modules and much of the reference materials are taken by the participants when they leave the workshop and therefore can be studied and used in the future.

While introducing the modular approach to learning, one of the staff can demonstrate the use of the A-T modules. This demonstration should include the procedure for obtaining an A-T module, putting the cassette tape and carousel in the player, running the equipment, including pausing and going back over specific information, rewinding the tape, returning the module, and what to do if something goes wrong.

The final part of the introductory portion of the workshop should be a discussion of the design problems and dividing the participants into workgroups. Each participant should have a copy of all of the design problems. One of the staff can outline each problem to the group as the name of the community is written on the board. Figure 1 shows the board from one of the past workshops. After all problems are briefly discussed, the participants are asked to sign up for a particular design problem. If the participants are not evenly divided, one or two can be asked to change groups.

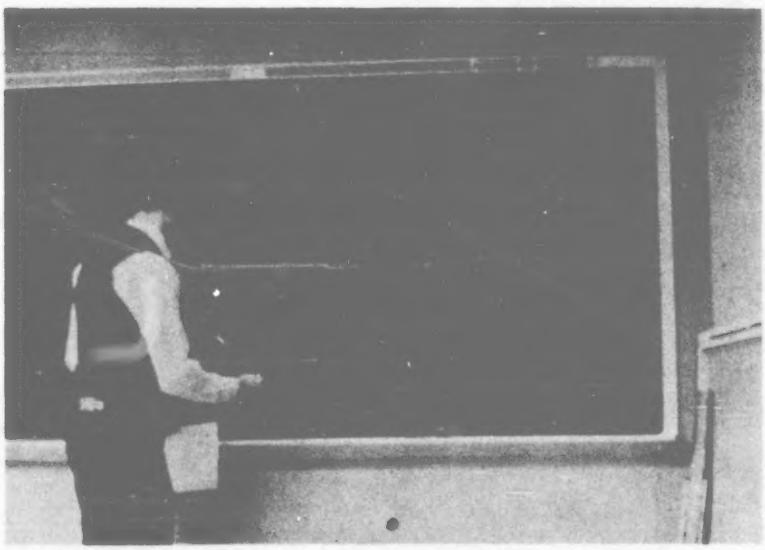


Fig. 1. Recording participant's selection of design problems. Design problems are presented, questions answered, and individuals select their design problem.

Another option for dividing the whole group into workgroups is to have the staff assign participants to a design problem. This can be done before the beginning of the workshop. With pre-registration material, the staff should know the background, experience, and responsibilities of each participant. Using this information, the staff can divide the group either randomly or according to some criterion. For example, it may be desirable to have a person in each group with considerable design experience and another with regulatory background, or perhaps, those participants with little experience should be spread out among the groups. The groups can be more balanced if they are made up before the workshop, but this method limits the choice that the participants have concerning those with whom they wish to work and the design problem on which they will work.

Participants may sign up for a particular design problem, or the staff may divide the group according to background, experience, and responsibilities.

After the participants have formed workgroups, it is important that they be given specific instructions for beginning their work. (These are summarized in Table 4.) Module I-2, "Design Procedures for Land Application of Wastes," is a general guide for getting started on the modules and the design problem. It is strongly suggested that all of the participants first proceed through all of the Level I modules. These modules cover the basic principles in a general way and are a key to developing a Level I design. As is suggested in the Design Procedures module, at this point the workgroups are trying to find the limiting characteristic in the problem and developing preliminary costs, rather than developing a detailed design. The participants should realize that the decisions made during the Level I design phase are tentative and will most likely be revised in the Level II phase of the workshop. Table 5 indicates a summary sheet that can be handed out to the workgroups at this point in the program or later in the day. Along with the Design Procedure module, this summary sheet will help focus the design aspects of the workgroups' efforts.

Level I modules cover the basic principles and are a key to developing an initial design.

Except for a brief introduction to the Level II design procedure later in the week, this concludes the introductory phase of the program. The introduction to the Level II design should cover the points in Table 6. The first introduction is the only part of the program that can be tightly planned and orchestrated. The other activities of the workshop vary depending upon the way the workgroups proceed and the designs they develop. It is desirable to have all segments of the introduction planned in advance, because it is the part of the program that introduces the staff to the participants and vice-versa, guides the workgroups, and develops the very important positive first impressions that will shape the week-long interaction.

A carefully planned introduction serves the dual purpose of presenting information and establishing a suitable climate for positive interpersonal relationships. The remainder of the workshop must be flexible enough to meet variations in the development of design problems.

TABLE 4

SPECIFIC INSTRUCTIONS FOR WORKGROUPS TO BEGIN THE LAND APPLICATION OF WASTES DESIGN PROBLEM

1. Check module contents (and any other materials provided) for sources and kind of information.
2. Review the "Design Procedures" module to identify general design approach.
3. Study all of the Level I modules.
4. Appoint a spokesman or leader.
5. Identify the kind and cost of conventional treatment for the problem situation. (This might be eliminated for shorter workshops of 3 days or less.)
6. Determine the limiting parameter for the wastes and relative land area required.
7. Identify the presence of an adequate amount of land for the specific processes.
8. Note presence of any special land features, such as wetlands or permeable soils adjacent to impermeable areas, which may be investigated for process modification in Level II design.
9. For hydraulics, look at all three land treatment processes if suitable land is located.
10. Determine the crop, if any, and its effect on treatment.
11. Identify storage needs.
12. Estimate costs of land treatment processes.

----------USE LEVEL I MODULES FOR STEPS 1 THROUGH 12----------

13. Determine initial feasibility for Level I. (Compare costs with conventional treatment.)
14. Develop presentation. Design visual aids. Prepare presentation strategy.

TABLE 5

LEVEL I SUMMARY SHEET FOR REPORTING RESULTS FROM DESIGN GROUPS

Group Problem	Design Flow MGD	Conventional Treatment	Land Treatment	Limiting Parameter	Cost (¢/1000 gal)							Comments
					Conventional			Land				
					C	O&M	Total	C	O&M	Total	Income	

TABLE 6

FORMAT FOR WORKGROUPS TO BEGIN THE LEVEL II DESIGN

1. Appoint a new leader or keep the same one as in Level I.
   (a) Leader delegates responsibility for the aspects of Level II design to the members of the workgroup.
   (b) Leader and workgroup members assemble the information and develop the Level II presentation.
   (c) All of the modules should be covered by the workgroup. Each member of the workgroup, however, may not review each module. The leader delegates responsibility to the members to ensure that each module will be covered.
2. Based upon Level I information and presentatior, decide on items that need further evaluation.
   (a) Source modification
   (b) Combination of land treatment processes
   (c) Different locations and crops
   (d) Land treatment components--pre-application treatment, storage, drainage, etc.
   (e) Other considerations.
3. Briefly refine conventional treatment processes and costs.
4. Re-evaluate limiting parameter based upon more detailed considerations.
   (a) Concentrate on reducing the concentration or amount of the limiting parameter in order to reduce land area.
   (b) Modify the land treatment system or combination of land treatment systems to control more effectively and efficiently the limiting parameter.
5. Sharpen costs of land treatment.
6. Determine Level II feasibility and prepare presentation.
   (a) Use visual aids for presentation.
   (b) Anticipate questions which may be asked.
   (c) One or more members may participate in the presentation or ensuing discussion

CONDUCTING WORKGROUPS

Each staff member usually will be responsible for the progress of two of the design workgroups. The way that this person interacts with the workgroups will play a large part in determining the lasting impression that the participants have of the competence of the entire workshop staff. It is important that the staff quickly establish a good working relationship with the participants in the group. The staff's job is to guide, support, and help the workgroup, not to provide solutions to the design problems. Figures 2, 3, 4, and 5 show the workgroups at work and staff members interacting with them.

It is important for the staff member associated with each design workgroup to establish a rapport and provide support rather than solutions.

It is the staff member's, or tutor's, first job to see that the workgroup begins to study the Level I modules. There are a few ways of encouraging this and combate the tendency to begin work immediately on the design problem. Be quite emphatic that the group members go through Module I-2, "Design Procedures," first. This module will suggest a way of attacking the design problem in conjunction with the Level I modules. It is advisable, also, not to provide much additional material concerning the design problem as the group first begins their work. About the only information that might be provided right at the beginning are the USGS 7½' topographic maps. These maps will give the participant a general idea of the location of the community in the design problem and the surrounding topography. While the maps may fascinate some of the participants for a time, encourage them to begin on the modules after a reasonable amount of time looking at the location of the design community.

It is advisable to go through the design procedures module before beginning work on the problem. There should also be limited material distribution at the outset.

USGS 7½' topographic maps should be distributed in the beginning so that participants get a general idea of community location and topography. SCS Soil Surveys should also be provided early in the work process.

After the participants have studied "Design Procedures" (Module I-2), there is no set pattern for proceeding through the Level I modules. Most of the participants will try to study the A-T modules. Since there is usually a limited number of slide-tape players, some of the participants will have to read the written modules. The staff should assure the group that essentially the same information is provided in both modes.

During the early part of the Level I design, the SCS Soil Survey should be handed out to the workgroups. Figure 6 shows a group using the soils survey in conjunction with the topographic maps. This will get to be a familiar scene as the week progresses, since these are the two main sources of information, other than modules, for a design problem solution.

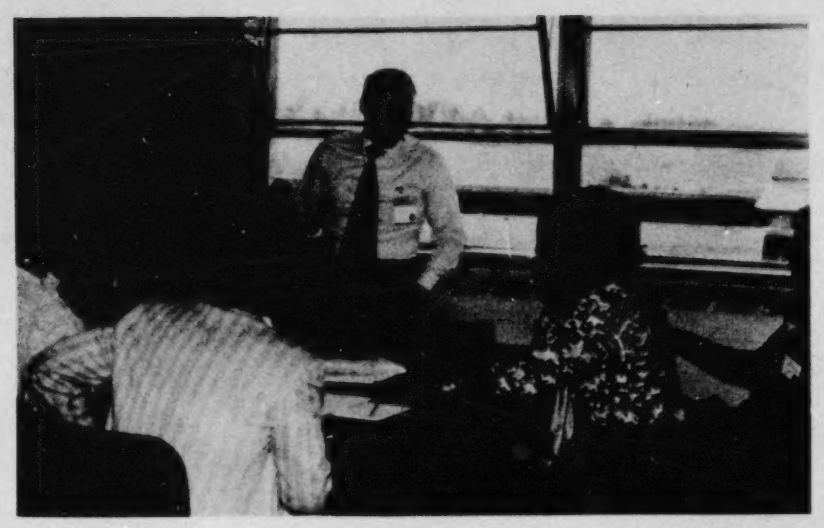


Fig. 2. Staff member (standing) discussing a question with a workgroup.

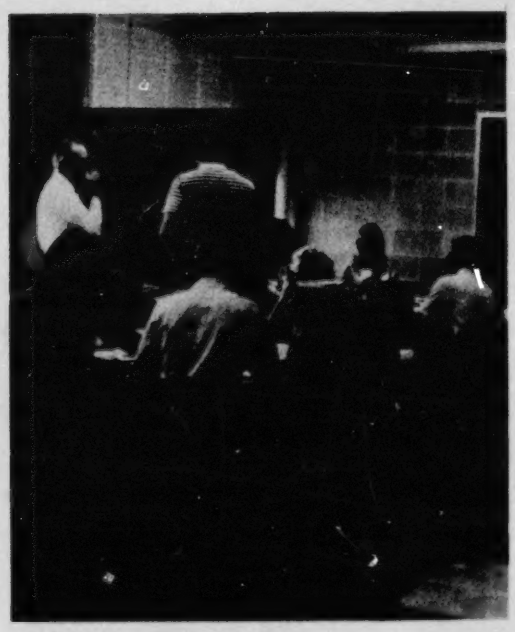


Fig. 3. Visiting consultant at the blackboard (white shirt) providing additional information to one member of a workgroup.

Fig. 4. A workgroup engaged in study of material in printed modules.

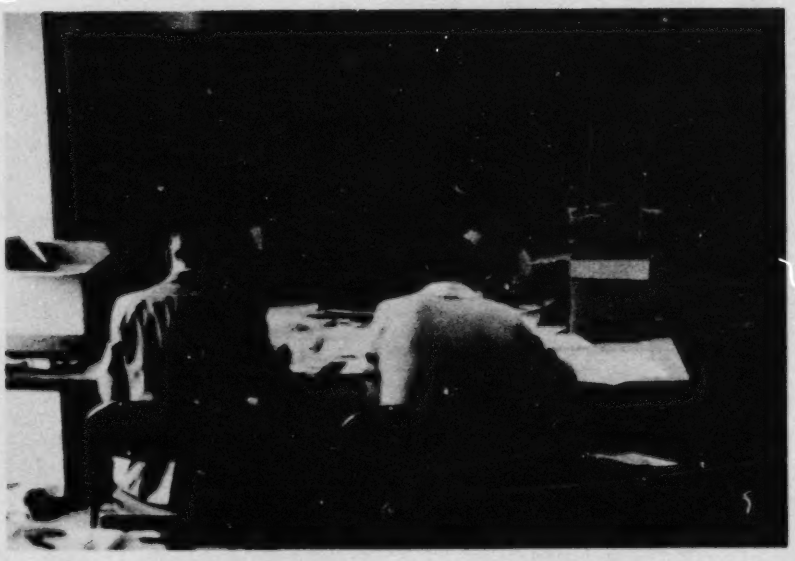


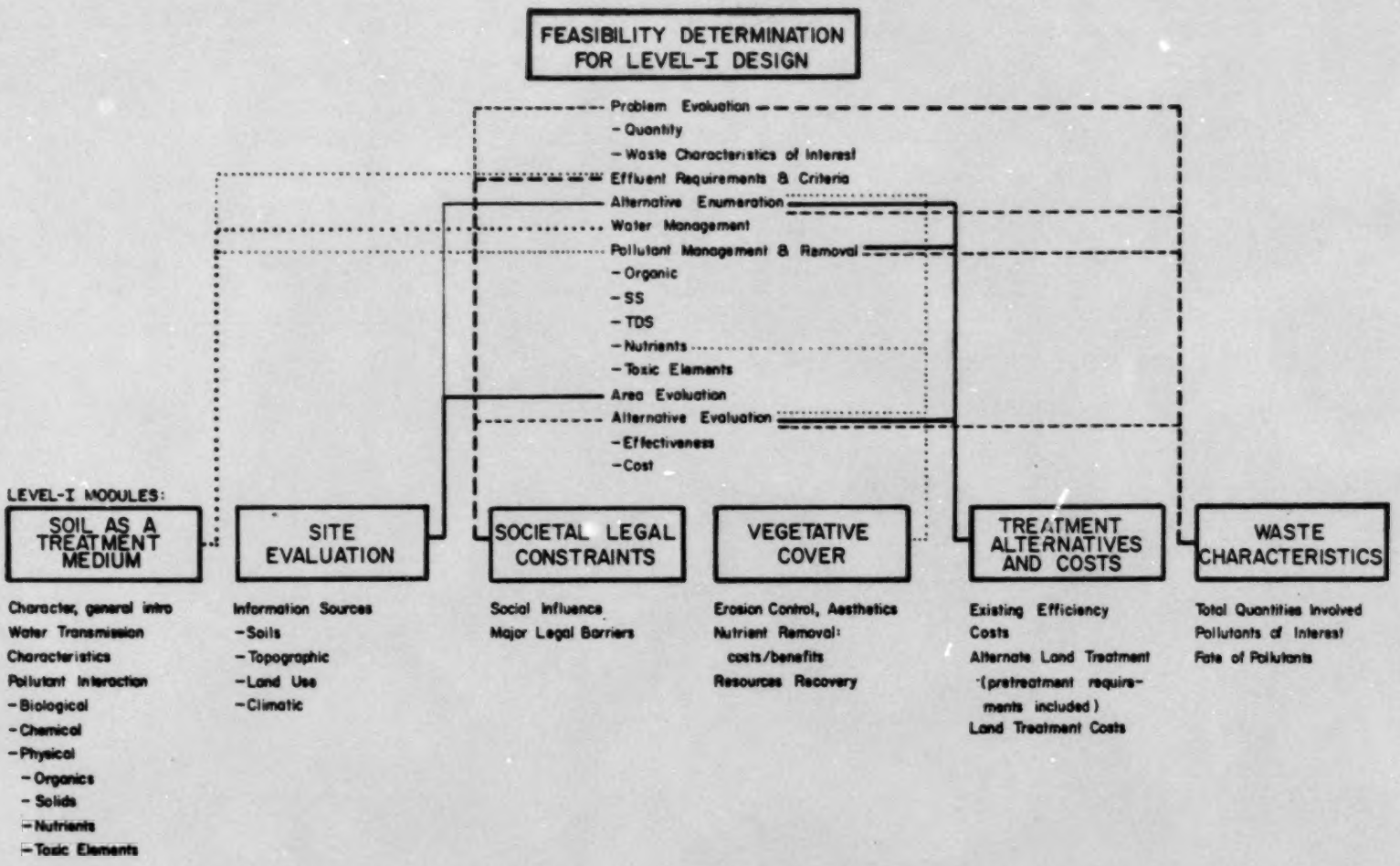
Fig. 5. A workgroup probing materials for answers to specific questions.

Fig. 6. Group using soil survey in conjunction with topographic maps.

Once the workgroup begins to get into the modules, there is usually some question as to the relation between the information in the modules and the Level I design solution. For the land treatment part of the Level I design, the group is looking for four basic pieces of information: (1) the limiting characteristic in the problem; (2) the amount of land necessary to safely control that characteristic; (3) the cost of land treatment; and (4) the availability of the necessary amount of land close to the community. They are also required to find the cost of an alternative conventional treatment system (although this step might be eliminated in shorter workshops). All of this information can be found in the Level I modules. The chart in Figure 7 indicates the relationship between the design problem and the Level I modules. This chart is also in Module I-2, "Design Procedures." Each module in the Level I series contributes to the solution of the design problem as well as to indicate the basic principles of land treatment.

In a Level I design, the workgroup concentrates on the limiting characteristic, the availability and amount of land, and the cost of land treatment and conventional treatment.

Fig. 7 LEVEL-I FEASIBILITY OF LAND APPLICATION OF WASTES
(TOPIC INTERACTIONS)



Module 1 - "Soil As A Treatment Medium"-- indicates the basic properties of soil in relation to land treatment and helps indicate the limiting characteristic of the problem and the kind of land treatment to choose.

Module 2 - "Design Procedures"-- (see above, page 11).

Module 3 - "Waste Characteristics"-- indicates renovation efficiencies of conventional land treatment. Helps with describing the limiting characteristic and treated effluent characteristics.

Module 4 - "Treatment Systems, Effluent Qualities and Costs"-- indicates the conventional treatment options to use for the design problem and the cost of land and conventional treatment. Also indicates pre-application treatment for land application.

Module 5 - "The Role of Vegetative Cover"-- indicates the contribution that vegetation makes in land treatment. The amount of land necessary for safely applying waste to the soil if vegetation is to be used in controlling the limiting factor is also discussed.

Module 6 - "Site Evaluation: General Criteria - Information Sources"-- indicates how to choose a site and use references provided.

The only information necessary for a Level I design that is not in the Level I modules is a "ballpark" figure for the amount of storage necessary. This kind of information can be inferred from the temperature and precipitation data which is supplied with the design problem. Also Figure 1 in Module II-6, "Climate and Wastewater Storage" can be reproduced or referred to for a first estimate of storage.

After completion of a Level I design, a summary sheet is filled out and findings are presented to the other participants.

On the second afternoon of the workshop, the Level I design should be complete. This means that the group should have filled out the Level I summary sheet and is prepared to give a presentation to the other participants. One member of the workgroup, often the leader, becomes the spokesman. The whole design group, however, should help in the preparation of the presentation. Each group can use the acetate sheets to develop visuals for the presentation. These visuals can include area requirements, costs, perhaps a tracing of the potential sites from the topographic maps, and final effluent parameters. Figure 8 shows a workgroup preparing its presentation.

The group will also have to prepare a Level II presentation. This is slightly different from the Level I presentation in a few ways. Not all of the members of the design group need cover every subject area during the workshop for Level II. Thus, the labor for the Level II design can be divided up and individual members report the options available for the design in a particular subject area. One member, for example, can be the expert in water storage for the group, while another can cover crop selection. The various members

In a Level II presentation, various subject areas are covered by individual group members. Refined costs and other revisions are listed in the Level II summary sheet.

Fig. 8. Workgroup preparing group's presentation using acetate sheets to develop visuals.

of the group will have to report to the design group in developing the Level II design and will have to brief the person in the group who will be giving the report. The person who is giving the report can, during the presentation, refer questions from the other participants to the expert in his design group in that subject. The presentation can also be divided among a few members of the group, each person presenting an aspect of the report. The design group also should be encouraged to use the acetate sheets for the overhead projector in the preparation of the report. These sheets can be used to outline the whole system, including current land use, location of pumping facilities, application and storage areas. Costs for the Level II design should be refined and summarized on the Level II summary sheet (shown in Table 7), and indicated in perhaps more detail, on an acetate overlay for the presentation.

Group Dynamics

Each workgroup at a workshop will develop its own personality depending upon the personalities and interactions among the members of the group. It is the tutor's responsibility to attempt to make the workgroup as productive and harmonious as possible by dealing with the personalities within the group as well as with the whole group. Every group needs a leader and usually one will develop as the group proceeds. If a leader does not develop then the tutor could suggest that the group choose one. The leader's responsibility is to record the decisions of

The tutor must be cognizant of individual personalities within the workgroup. It is desirable to select a leader, if one does not naturally surface, who will record decisions and oversee adequate attention to all topic areas.

SUMMARY - LEVEL II FEASIBILITY CONSIDERATIONS

Group	Problem	Design Flow, MGD	Conventional Treatment Type	Land Treatment Description	Land Area Required			Limiting Parameter	Preappli-cation Processing	Storage	
					Total Ac Area	Treatment Area				MG	Days of Flow
						Acres	Ac/MGD				

TABLE 7. LEVEL II SUMMARY SHEET. Copies will be filled in during group presentations and data for the participant's group should be recorded in advance.

SUMMARY - LEVEL II FEASIBILITY CONSIDERATIONS

Revenue				Costs			Land Treatment					Special Features	Comments
Income Product, ¢/1000 gal				Conventional									
Nut.	Water	Crops	Energy	Cap.	O & M	Total	Cap.	O & M	Total	Rev.	Net	Land Agreements, Pathogens, etc.	

TABLE 7 (con't). LEVEL II SUMMARY SHEET. One row to be completed by each group for their design problem, and other rows to be filled in during group presentations.

the group and to make sure that all of the topic areas (modules) are covered. This is especially important for the Level II design when each person may not study every module.

The pace of the group has to be constantly monitored to make sure that it remains close to the schedule. Going into too much detail, confusion about the assignment, or working too slowly are three reasons a group may be falling behind. The first reason, going into too much detail, usually happens during the preparation of the Level I design. The workgroup should be reminded that Level I should only be a preliminary feasibility design. Specific sites should not be chosen, exact cost estimates are not necessary, and the needed land acreage should be a best estimate. If the group is going into too much detail, it can be beneficial to identify a specific detail and as an example of specificity that would be more appropriate for the Level II design.

If a group falls behind schedule, it may be due to an overemphasis on detail, confusion about the assignment, or working too slowly.

If the workgroup is confused about where to begin, even after reading the Design Procedures module and other Level I modules, then the tutor must step in with some kind of guide or hint. A few key questions about the specific design often sets the group on the right track. Asking how much land is necessary for the safe control of the nutrients can be a good place to start. The participants can figure that out from either Module I-1, "Soil As A Treatment Medium" or Module I-5, "The Role of Vegetative Cover." If they do not know where to find the information, even after reading the modules, then the tutor must show them. Another question such as the kind of land treatment system--overland flow, irrigation, or rapid infiltration--the group is going to use, and why, can also start a group on the track. As time passes, the tutor may have to give more and more direction to get the group to proceed at an adequate rate. A group must not remain confused for long. Remember, however, that some confusion always goes with new learning, until the newly learned information is adequately integrated and organized. This is not the kind of confusion about which a tutor should be concerned.

If the tutor is sure that the group is not confused and is simply working too slowly, the workgroup can be reminded of the "benchmarks" that are built into the schedule. These include: (a) determination of the limiting factor by either the last part of the first day or early on the second day; (b) presenting the Level I design on the second day; and (c) discussion of Level II topics on

The "benchmarks" built into the schedule may serve as reminders to those workgroups moving at too slow a pace.

the third day. These "benchmarks" are in the schedule for several reasons, one of which is to help the participants keep up and to indicate the amount of material that should be covered by specified times in the program.

The opposite problem may also occur; some groups proceed too fast. This usually happens when one or two members of a group feel they have had extensive previous experience with land treatment. Some members of the group may want to charge ahead with a design before reading any of the Level I modules. This can be a difficult problem for the tutor to solve, especially with several members in a group being knowledgeable in various aspects of land treatment. It is important to stress that the main objective of the workshop is to learn the fundamental principles of land application with the design problem being simply a vehicle for learning these principles. This often will get the group to read the modules and do the design problem in conjunction with the modules. If the group still persists in working on the design problem without the aid of the modules, then the tutor must resort to other tactics. If possible, the tutor should point out the specifics in the design that are not satisfactory or that could be done another way, considerations that should be involved, where the design could be improved, and what modules could help the group design a more cost effective system. For example, in a previous workshop, one group insisted that they wished to take a few minutes to work on the design problem before they got into the modules. The few minutes turned into well over an hour. The only way the tutor persuaded the group to begin the modules was to point out why their system would not work, even though it would have been a good system for most areas of the country. The group had planned an irrigation system, but the soil in the area had very little permeability, less than 0.2 inches/hour. When they realized that the design would not work, they began the Level I modules. The tutor, to handle all situations, must know the variables in the design problem and the information in the modules.

When a group proceeds ahead of schedule by concentrating on the design rather than the modules, it is important that the tutor stress that the main objective of the workshop is to learn the fundamental principles of land application with the design problem serving simply as a vehicle for learning these principles.

It is also the tutor's responsibility to attempt to integrate the design group into a harmonious unit that benefits everybody in the group. This is occasionally made difficult by various personalities in the workgroup. Sometimes an individual tries to dominate the group--the "know it all." If this seems to be abrasive to the other members in the group, then the tutor should attempt to balance the contributions of the group members. One way

of doing this is to direct questions to other members of the workgroup. Questions to other members should be of the kind which can be called "divergent questions." Divergent questions are questions that require use of basic principles, and recognition of these principles, as opposed to "convergent questions," which call for specific detail or a correct, single, known, answer. A convergent question is: "What is the average annual rainfall on this site?" or "Is rapid infiltration appropriate for this situation?" A divergent question is: "What kind of system do you think would be best for this situation and why?" Asking divergent questions to other group members will give them a chance to express their opinion.

Another way of shortcircuiting the "know it all" is to listen politely to his comment and then not comment on it. Instead of commenting, go on with a new question or even a different topic with other members of the group. This is more blunt than the last method, but it may be necessary on occasion.

In an extreme situation, the participant may have to be confronted directly. This should be done when you can get the person alone. If tact is used, the "know it all" will immediately reform, at least for a time. One approach that has been effective is to say, "Look, some of the guys in the group don't catch on to this as fast as you do. You have so much experience in this area that you are giving all of the correct answers before they have completely learned the material. If you can hold off with the answers for a little while, you can be of more help to the other members of the group." The tone of this suggests cooperation between the participant and the staff to help the other members of the design group.

Another situation, although less serious for the whole group, is when a member does not join in the group effort. If the participant seems shy he can often be drawn into the group by asking him first a convergent question during a discussion. Be sure, the first time this is tried, that the subject knows the answer either from his previous experience or the modules. Then ask a related divergent question dealing with the general subject under study by the group. This strategy helps the individual recognize that he does have pertinent knowledge to contribute. There are people who, for one reason or another, do not wish to function as part of a group, even after encouragement to do so. This wish must be respected.

The tutor must be familiar with variables in the design problem and information in the modules. He must also maintain harmonious group interactions, dealing with the "know it all," the shy participant, and the unhappy complainer. In most workgroups, these extreme personality types are a rarity.

Occasionally, there will be a participant who is unhappy with the whole workshop. Most of the reasons for this are usually not connected with the workshop itself. These can include family problems or being forced to attend the workshop by an employer. Even though this individual is unhappy for reasons unrelated to the workshop, the complaints will concern any and all aspects of the workshop situation. A staff member should discuss the complaints privately with the individual to ascertain their validity. If the complaints are legitimate, then an effort should be made to rectify the situation. If the person is not receptive to the whole workshop situation, then he must be shown that the complaints are not legitimate and that others are functioning well in the same situation. If he is complaining to the other participants, then his complaints will have to be dealt with in front of the group to which he is talking. If he is unhappy with the way the workshop is set up or conducted, it can be suggested that he work alone on his own problem. This is a last resort measure after other tactics have been tried. One or two people in a workshop who are very unhappy or negative can spoil the whole atmosphere for everyone else. These people should be isolated, as much as practicable.

Occasionally, one participant will object to almost everything in a workshop. This person requires special attention and may have to be set apart from other groups.

This section concerning group dynamics should not discourage a person from conducting a workshop. Most of the time the workgroups run very well. The members of the workgroups do draw upon the expertise and experience of each other, the tasks are divided up well, and a lot of learning goes on resulting in a well done design. Workgroup activities are usually rated very high by most participants on their evaluation of the program. This section has been included in the Instructors' Program to prepare the instructors for the various possibilities that can occur. It should not be interpreted to indicate that these situations are the norm in workgroup activity.

Conducting Discussions

There are several times during the workshop when a general group discussion may be needed. These include the discussion of early problems on day 1, discussion of the Level I and Level II designs that the workgroups present, and discussion of particular topics on day 3. It has been found that when the daytime activities end with a general group discussion, the participants usually leave on a "high" note. A discussion is a change of pace from working directly with the modules and is also somewhat less strenuous than working in small groups on the design problem. If the discussion is well run and the staff is comfortable with the situation, there is a great benefit to the whole workshop atmosphere from this kind of activity.

Discussions conducted at various points during the workshop serve to lessen the somewhat strenuous pace, inform participants about subjects of interest, and ascertain understanding of concepts presented in the modules.

Other purposes of these discussions are to inform the participants about subjects of interest as well as to ascertain a general level of achievement of the group on the concepts presented in the modules. To a great extent the participants will be interpreting their understanding of the learning material for the group during the discussion periods. The staff's job during these discussions is to listen carefully to the contributions that the participants make to be sure they agree with the principles in the modules, and they reflect having studied the modules.

It is usually a good idea to begin a discussion by having a brief presentation. For the discussions that follow each of the Level I and Level II presentations, this is already built into the program. For the other discussions, however, a brief introductory presentation can be planned by the staff. For example, a case history focusing on nitrogen control would be a good way to begin a discussion on nitrogen. It is also a good idea in any presentation to have as many visuals, either slides or drawings for an overhead projector, as practical. This is especially true for initiating a discussion. This allows the participants to have material to which they can refer.

It is a good idea to preface discussions with presentations, using visuals to which participants may later refer.

In a large group in which the members have varying amounts and kinds of experience with the subject matter, it is important to watch out for one or a few people dominating the discussion. Try to draw out the other members of the group with answerable "convergent" kinds of questions. Try to repeat parts of what the more shy people contribute indicating that the information is important. This will have a tendency to encourage contributions to the discussion from those who usually do not say anything. It is never proper for a discussion leader to "put down" what other people contribute to a discussion or to be rude in any way. This is as true when responding to those who dominate the discussion as to the other members of the group. If somebody is incorrect in a conclusion or point that he is making, give the other members of the group an opportunity to respond. Usually one of the group will indicate where the person is off the track. At all times, it is important that the staff not dominate the discussion even if they have the "right" answers. It is very easy for a discussion to turn into a lecture, but this is not as effective for learning, or for ascertaining the understanding of the participants.

The staff should be careful not to allow one or a few people to dominate the discussion. Asking "convergent" questions, encouraging contributions from the less verbal, and allowing group members to respond to one another will encourage involvement of most of the group.

DESIGN REPORTS

Figures 9 and 10 show participants presenting the results of their design group's work. Each report is usually about ten minutes long with five additional minutes allowed for discussion. The completed summary sheets, previously shown in Tables 5 and 7, should have been given to all of the participants. The staff should feel free to participate in these discussions, which are led by the person presenting the report. Of course, the staff should give preference to other participants in contributing to this discussion. The staff's questions concerning the design, for that is usually the content of these discussions, should direct the speaker to clarify basic principles that are reflected in the design. For example, questions regarding the amount of nitrogen applied per acre and how the design group came up with its figure should receive a response about the nitrogen cycle and its relationship to land treatment.

Design reports are presented by each group, followed by a discussion period in which principles are challenged and clarified. All participants receive copies of the completed summary sheets.

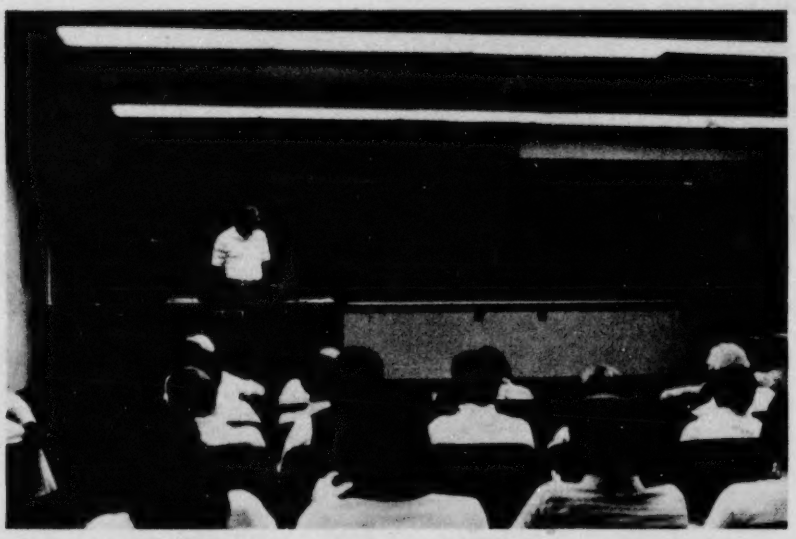


Fig. 9. One participant presenting results of his design group's work.

The discussions concerning the designs are usually the most lively of the workshop, other than the public hearing. This is especially true if two design groups work on the same problem independently. In this case, there is usually time for only one of the design groups to present its design at each presentation. If there is a Level I and a Level II presentation, one group can present its results at the Level I presentation and the other at the Level II presentation, thus providing each

group with a chance to present its results and to question the results of the other group. All groups will still complete a summary sheet, however. About an hour before the presentation, the group making the presentation should be notified.

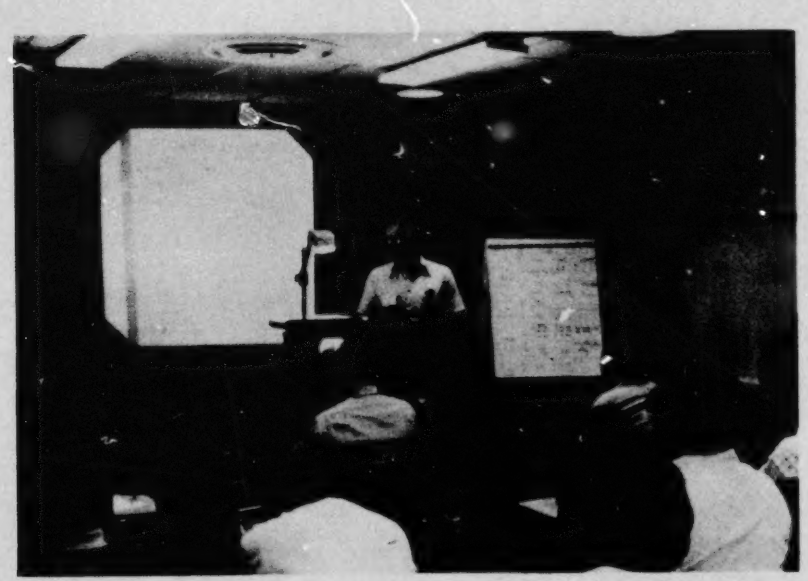


Fig. 10. A participant presenting a segment of the results of his design group's Level II analysis.

EVENING PROGRAMS

Another kind of discussion is often held in the evening. The schedule in Table 1 calls for three evening programs. These should be optional for the participants, but very interesting and informal. Since it is not always practical for all of the participants to attend these evening sessions, the program should deal with informative supplementary information, not information that is essential for the whole group to know and understand. This kind of program can consist of films of existing systems, slides of site visits, or discussions of new or unusual research results. The presentation should be provocative enough to be the focus of the discussion that should follow.

Optional evening programs afford the interested participant the opportunity to receive informative supplementary information.

DISTINGUISHED SPEAKERS

A distinguished speaker may be scheduled every day, preferably after lunch (see Fig. 11). The talk, including a question period, should be limited to one hour. The speaker's job is to present information concerning topics of special interest that are not covered in great depth in the modules, or to present information on topics that may have changed

since the modules were developed, such as laws pertaining to land treatment, or to report on personal experience with a particular design or research. The speaker should, of course, be interesting and have visuals as part of the presentation. This is especially important with the time slot for the speakers, since many participants will have a tendency to doze during a boring presentation.

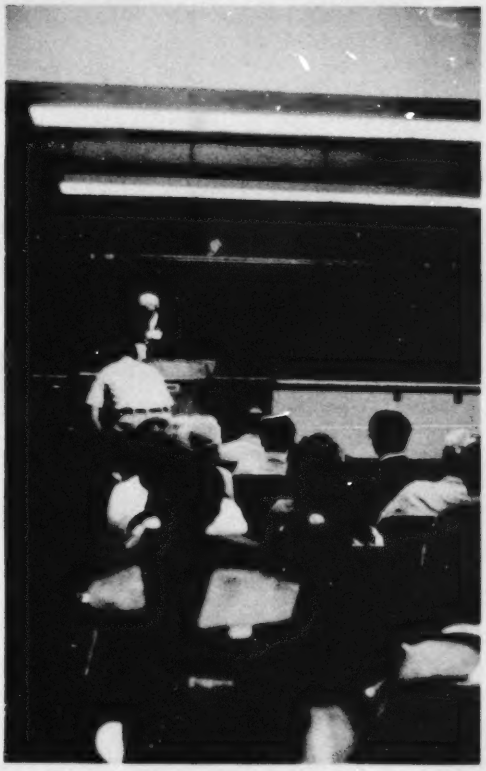


Fig. 11. Mr. Belford Seabrook, formerly with the Municipal Construction Division, EPA, was a distinguished speaker at a workshop. His topic concerned EPA's role in land treatment.

The speaker should arrive early enough and stay on after the talk to interact with the participants while they are working in the design group or for the evening program. An early arrival allows a staff member to ascertain the kind of A-V equipment necessary, set it up, and load any slides or film that will be used.

Distinguished speakers may cover topics of special interest, update information, or relate personal experiences in design or research areas. An hour session should include a presentation as well as discussion and questions.

The speaker should limit the presentation to about 30 to 45 minutes to allow time for discussion and questions. If the speaker does not call a halt after about an hour, one of the staff should indicate that the time is up. Suggest that those participants who wish to ask questions can remain or see the speaker later, but the formal part of the presentation and discussion is over.

CONDUCTING A FIELD TRIP

A field trip, whether to a well-designed and well-run facility or to a poorly designed or poorly run facility, is an excellent learning situation (see Fig. 12). The participants should relate the information they have learned to this actual situation. For this reason, it is strongly suggested that the trip be scheduled to take place after the participants have at least finished the Level I modules and design.

Fig. 12. The person in charge of the land treatment site is explaining the operation to the workshop participants on this field trip. This workshop field trip was to a sludge farm.

Module A in this Instructor's Program indicated directions for arranging the field trip. The group should be divided into subgroups that can tour the site conveniently and see the various features that are pointed out. For most land treatment sites there are two or more convenient places for beginning a tour. One place is at the beginning of the pre-application treatment; another, at the beginning of the application area. The participants will probably be interested in the waste characteristics at several points in the operation. Allow enough time to tour the facility completely, but do not allow the tour to lag. In most instances the participants will be fairly knowledgeable about the steps in the operation that are the same as in conventional treatment, i.e., preliminary, primary, and secondary. These steps will not have to be described in detail during the tour. A longer time will be required for the land treatment portion of the tour. This includes storage facilities, control area, application area, and monitoring facilities.

PUBLIC HEARING SIMULATION

A simulated public hearing, using a role-playing situation, enables the participants to understand the community concerns in a land application system as well as the difficulties encountered by experts associated with the project.

Perhaps the greatest hurdle which designers of land application systems must overcome is public fear of this waste management alternative. If a community is unsure of what land treatment entails, it may attempt to halt such a project. It is necessary for those associated with land treatment, both from the design and regulatory end, to be aware of the concerns which a community is likely to express when introduced to the land application alternative.

Concerns usually surface at a public hearing when a consulting engineer first describes the alternatives available to the community. In most cases, there will have been some news coverage of the engineer's findings prior to the hearing. People will come to the hearing with varying levels of knowledge. Their concerns will range from direct technical questions to emotionally-based allegations of neglecting the health and welfare of the community.

In order to illustrate what might transpire at a preliminary public hearing on land application, it is helpful to use a role-playing situation. The participants actually take on the roles of various members of a hypothetical community (see Fig. 13). By describing a sample community and defining the roles to be played by several of the participants, it is hoped that the group will express nearly all of the concerns which a community might voice in a real life situation.

Fig. 13. A participant at the simulated public hearing is reacting to the "expert's" response. Notice the reactions of the other participants.

Module A of the Instructors' Program, "Preparing for a Workshop," indicated the materials that are to be prepared in advance. These include a map of the hypothetical community keyed to the roles which will be used. Thus, if a participant is to take the role of a farmer, the map should show where the farm is, and perhaps some of the physical characteristics of the farm. All of the roles which are to be assigned to the group should also have been prepared ahead of time.

The role playing situation should be introduced by one of the staff, and the objectives of the activity should be defined. These objectives center around the need to identify public concerns regarding land application of wastes, and the need for open communication during planning for land application systems. If possible, the introduction to the activity and the distribution of the roles to be played should be done about a day ahead of the actual simulation. This may not in all cases be possible. Each participant should receive a definition of the role he is to play, along with a map of the community. Although the role definitions should be prepared before the workshop, the assignment of the roles should be done by the staff the evening before they are handed out. The participants who seem to be the most willing to participate in discussions can be chosen for what the staff considers to be the key roles.

Key roles should be decided prior to the workshop, and assigned sufficiently in advance to allow for adequate preparation. A staff member familiar with conventional and land treatment acts as the consulting engineer, while participants play the roles of citizens with specific concerns.

A staff member should act as the consulting engineer, who is introduced by another staff member. The consulting engineer is almost always, in a small town, an "out of town" expert who has an impressive background and record and should be so introduced (usually with some humor). While the consulting engineer is not expected to be able to field all questions, he should try to be realistic about answering some questions and possibly evade others. If there is an obvious oversight or misstatement, the group will probably get more and more interested. Staff and other members in the audience can participate by asking particularly pointed questions, or questions which the "engineer" cannot answer, if the participants are not probing the consultant with demanding questions.

The key to success for this kind of activity is participant involvement and the agility of the consulting engineer. If the participants have been involved in several discussions earlier in the workshop and feel comfortable with each other, they will likely be enthusiastic about getting into the role playing situation. The staff member who plays the part of the consulting engineer must be able to field many kinds of questions without getting too flustered and must be completely familiar with conventional and land treatment systems. It is also helpful to have a large map posted or displayed on the overhead projector during the public hearing.

After the role playing situation has been played out, which usually takes a little less than an hour, a brief presentation can be given by one of the staff members. This presentation can emphasize the way that those planning a waste treatment site can work with the community from the very earliest stages of planning, and can take steps to avoid a traumatic public hearing. Some participants will have valuable experiences to relate from public hearings in which they were involved.

EVALUATION AND CLOSING PROGRAM

An evaluation form for the workshop should be ready to hand out at the next to the last day of the program (see Module A, "Preparing for a Workshop," for instructions on developing an evaluation form and a sample form). This part of the program is very important if other workshops are planned and to ascertain modifications that are necessary in the program. A summary report prepared from the evaluation forms can provide you with objective data for evaluation of your performance or to justify time-costs for the workshop to interested superiors.

A workshop evaluation by the participants helps the staff to determine modifications for future workshops.

After the Level II reports, on the last day of the workshop, a time should be scheduled for workshop evaluation. Written forms may be completed then (if not done earlier) and oral comments should be solicited. This gives the participants the opportunity to express concerns that are not on the evaluation form. One of the staff members, usually the head member, should conduct the evaluation. Another staff member should take notes on this session. It is also possible to tape record the session. Some participants, however, may not be as free with their comments if the tape recorder is running.

It is important that the staff not be too defensive during this session. The participants will be honest, generally, if the staff does not indicate that it is overly sensitive. Indicate that the comments presented in the evaluation session will help the staff conduct better workshops in the future. If there is an explanation for the concerns or shortcomings expressed, then the staff should feel free to present that explanation. Do not, however, apologize or harp on factors that are beyond the control of the staff. The perfect workshop or training program has never been run, so do not be overly concerned with critical comments.

An evaluation discussion session held on the last day provides participants with the opportunity to express concerns that are not on the form.

The last activity before officially ending the workshop is the presentation of the certificates of participation. These certificates help provide recognition of the participation of the individuals as well as of the workshop and its sponsor. Figure 14 is a photograph of the participants receiving the certificates presented at the end of the course.

Fig. 14. Participants receiving certificates at the end of the workshop.

Figure 15 shows a certificate used at an earlier workshop. Modifications in the certificate should be made to indicate the specific sponsors and the workshop title. Before the certificates are given out, the head of the workshop staff should present a brief summary of the workshop and a closing presentation. This portion should, of course, be very brief.

At the end of the course, certificates are presented to participants in recognition of their involvement.

CONCLUSION

A Land Application of Wastes workshop consists of a complex set of activities. All of these activities contribute to the basic objective of the Land Application of Wastes Educational Program--that is, to learn and be able to use the fundamental principles related to land treatment. The key to a successful workshop is a knowledgeable staff who understands conventional and land treatment concepts and who can work effectively in a complex situation. The land treatment modules are individualized to the extent that each participant works at his own pace, and much of the activity of the workshop revolves around small-group problem solving. This does not, however, lessen the importance of the staff. The staff must subtly guide all of the small-group work and be available as a resource for the individualized work. With a well-prepared staff who work well together and individually, the workshop is almost sure to be successful.

A staff versed in conventional and land treatment concepts with an ability to guide participants effectively does much to ensure the success of the workshop.

Certificate of Participation

This certificate is awarded to

in recognition of attendance and completion of the workshop

LAND APPLICATION OF WASTES:

an EDUCATIONAL PROGRAM

Held at University of California at Riverside

April 10—14, 1978

Developed at

Cornell University

College of Agriculture and Life Science

A Statutory College of the State University of New York

UCR – Coordinator

Director of the Program

Fig. 15. Sample Certificate.

****
* INSTRUCTOR'S PROGRAM *
****

Module C

BACKGROUND OF THE LAND APPLICATION OF WASTES
EDUCATIONAL PROGRAM

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OBJECTIVES

Upon completion of this module, the reader should be able to:

(1) Define the meaning of concept and to recognize the individual nature of each person's concepts.

(2) Distinguish between rote and meaningful learning and to illustrate the important role that existing concepts play in any new learning.

(3) Define the psychological processes of progressive differentiation and integrative reconciliation of concepts and to relate these processes to the structure and sequencing of learning material.

(4) Describe how the individualized, modular format accommodates for differences among individuals in prior concepts, experience and learning styles.

(5) Describe the role of the sample design problems and small group work to the acquisition of basic concepts needed and their application in "real world" land application of wastes problems.

(6) Describe the special skills and roles necessary for successful tutoring.

(7) Describe alternative formats for instruction in land application of wastes and their comparative strengths and weaknesses.

BACKGROUND OF THE LAND APPLICATION OF WASTES EDUCATIONAL PROGRAM

INTRODUCTION

The Land Application of Wastes Educational Program is a group of instructional modules that can be used within the framework of an intensive short-course or workshop, independent study, or as a segment of a conventional college course. The program has several unique aspects. One of these is that the program is based on a specific theory of knowledge and theories of learning, curriculum, and instruction which have guided the development of the program format and the organization of the modules. This module discusses the educational, psychological, and epistemological background of the modules and the workshop curriculum. This background also provides guidelines for those who wish to add to the program by producing additional modules for specific purposes and varied audiences.

The total program is based upon a theory of knowledge (epistemology) that places concepts at the focus of rational thinking. We define concepts as regularities in events or objects designated by a sign or symbol. For example, BOD is the regularity observed in wastewater that requires oxygen for the biological activities necessary to oxidize organic matter. Concepts are sometimes also called principles, and we use these terms interchangeably.

Consistent with our epistemology, we have applied principles from Ausubel's (1968, 1978) learning theory which places special emphasis on the important role of concepts we already possess in influencing our acquisition of new, related knowledge, or an elaboration of our existing concepts. The theory of curriculum (Johnson, 1967) we have employed places central emphasis on careful selection and ordering of concepts to be learned and on the use of instructional approaches that take cognizance of the variety of backgrounds in our adult target audience, and the selection of examples best suited to clarify the concepts we wish to teach. Some consideration of organizational or group theory also underlies the workshop format proposed in Modules A & B.

This module further provides information that can be used to adapt the Land Application of Wastes program to a variety of educational needs. The theory suggested here should assist educators with tasks associated with the use of the program and/or extension and modification of the program. A more complete discussion of the theoretical basis that underlies the program is available elsewhere (Novak, 1977).

PSYCHOLOGICAL AND EDUCATIONAL BACKGROUND

The design or evaluation of a land treatment or any kind of treatment facility is considered to be a problem-solving situation. Success at solving problems is directly related to the adequacy and organization of the concepts or fundamental principles a person has that are directly related to the problem. This section, therefore, will first discuss the nature of concept learning, how the concepts to be learned can be organized by the curriculum designer, and the relationship between the choice of the concepts to be learned and the choice of the instructional strategies to teach those concepts.

The design of a land treatment facility involves problem-solving behavior. Success in solving problems is contingent on how well the fundamental concepts are communicated.

The term "concept" has many and varied definitions. The one that is used here considers a concept to be a description of a regularity among objects, events, or other concepts. Thus the concept of "yellow" describes the color of light that a person perceives from objects reflecting or transmitting light of a particular range of wavelengths. The word "yellow" is a concept label. Concepts are also idiosyncratic. That is, each person differs in his understanding of a particular concept label. The concept "yellow" is a fairly simple concept, yet when people are given pieces of colored yarn with many in the green-yellow-orange range and are asked to pick out the yellow, there will be many different pieces of yarn picked. Even though each person's concepts are idiosyncratic, there are enough common elements to allow communication. There are concepts, however, that differ markedly among people and cultures, sometimes enough to essentially block communication. The concept represented by the term "moral" might be a good example. Think of the different meanings this concept word represents when used by a general in the army, a head hunter in the Amazon, a minister, and a college student. The idiosyncratic nature of concepts means that new learning will be somewhat different for each person, and this must be considered in the instructional approach described later.

Concept meanings are often peculiar to an individual or group, and this sometimes hinders communication.

Concepts vary in complexity and inclusiveness, depending upon the regularity or set of regularities they designate. The concepts that are associated with sewage treatment may not be as complex as the concept "moral"; however, they are quite complex and made up of several subordinate concepts. Examples of concepts associated with land treatment are: nitrogen cycle, cation exchange capacity, pre-application treatment, irrigation, and public health. Each of these "higher order" concepts subsume the meanings of many other concepts (e.g., ion, disease).

Another aspect of idiosyncratic nature of concepts is that each person has a different amount of meaning associated with a concept. Consider the very simple concept "dog." A young child may consider a dog as any animal with four legs and a tail. This concept would include what we call dogs, cats, horses, and goats. As the child grows, the concept of dog begins to refer to what most adults consider a dog. Other concepts are learned for cat, goat, and horse. The concept of a dog becomes more differentiated. This differentiation can be represented as in Figure 1. The object of education in waste treatment, as in all subjects, is to help the learner differentiate concepts and develop interconnections among concepts. The adequacy and degree of differentiation of concepts or basic principles an individual has will determine his success in planning, running, or evaluating a land application system. Therefore, instruction in the Land Application of Wastes program focuses on relevant concepts or principles to a greater extent than on design parameters. The proper design of a waste treatment system requires competence in applying basic principles to ascertain appropriate design parameters, but the focus of our program is on the acquisition of basic concepts, and only secondarily and in a limited fashion on design parameters.

Increased information helps the learner differentiate concepts and develop interconnections.

Fig. 1. Schematic of concept differentiation.

Ausubel's (1978) theory emphasizes cognitive learning. The results of this kind of learning is an organized store of information in a learner's brain. The organization of this information and the information itself in the brain is called cognitive structure. All of the knowledge we possess comprises our cognitive structure.

Ausubel's theory emphasizes a cognitive structure wherein meaningful learning is accomplished by relating new information to existing relevant concepts for the individual learner.

The single most important aspect of Ausubel's theory is his emphasis on meaningful learning. Meaningful learning is a process in which new information (concepts, examples, facts) is related to existing relevant concepts in an individual's cognitive structure. In other words, in meaningful learning new information is related to previously learned, similar information. This process can be schematized as in Figure 2. An example of this kind of learning might be when a person learns that there are surface methods of applying waste to the land as well as the spray application method with which he is familiar. This concept of "surface methods" may be related to many other concepts in cognitive structure including uniformity of application, cropping, energy requirements, treatment efficiency, and pathogen control. The degree of meaningfulness of this concept of surface application will vary from person to person depending upon the adequacy of these other relevant concepts and the learner's efforts in developing the relationships among concepts. Ausubel has coined the term subsumer to designate the functional concept in a person's cognitive structure for two reasons: (a) all concepts are somewhat idiosyncratic and (b) concepts in cognitive structure become modified as the subsumed new, relevant knowledge. Since the subsuming concepts an individual has will vary from person to person, both the rate of learning and the subsequent meaning will also vary. Thus, a person with little information about pathogens may not realize that surface methods of waste application affects pathogen dispersal. For this person the concept of surface application is less meaningful. The degree of meaning can be schematized as in Figure 3.

It is possible to learn new information with little or no linkage being made with existing concepts in cognitive structure. This kind of learning is called rote learning. Material may be rotely learned for either of two reasons. The material may have little potential meaning, such as telephone numbers or multiplication tables, or the learner may choose, consciously or unconsciously, not to relate the new information to existing information in cognitive structure. Of course, the rote-meaningful distinction is a continuum rather than a dichotomy since almost all learning material has varying amounts of potential meaning.

In another method, called rote learning, new information is not linked to previously existing concepts. This is often used by the learner when the material has low potential meaning.

Figure 4 indicates, symbolically, the two forms of learning.

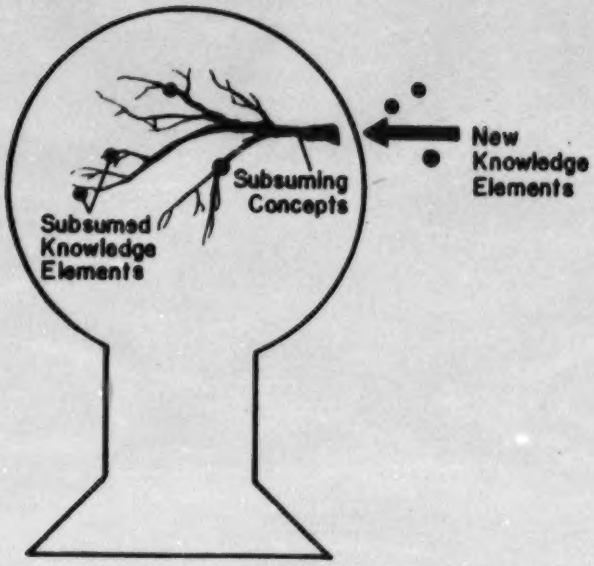

Fig. 2. In meaningful learning, new knowledge is subsumed by existing concepts in cognitive structure (Novak, 1977).

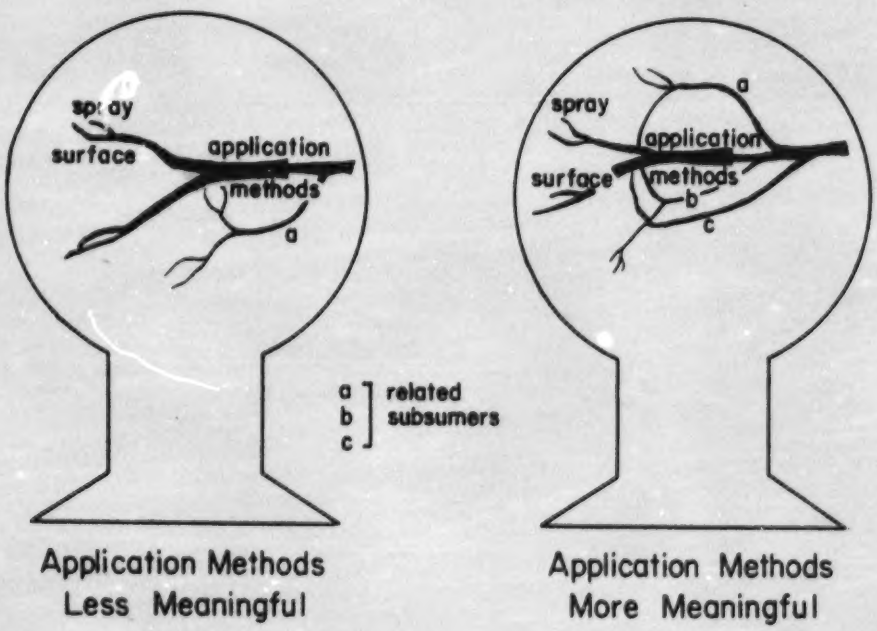

Fig. 3. Degree of meaningfulness of new information depends upon the relationship that is established between new information and previously learned concepts.

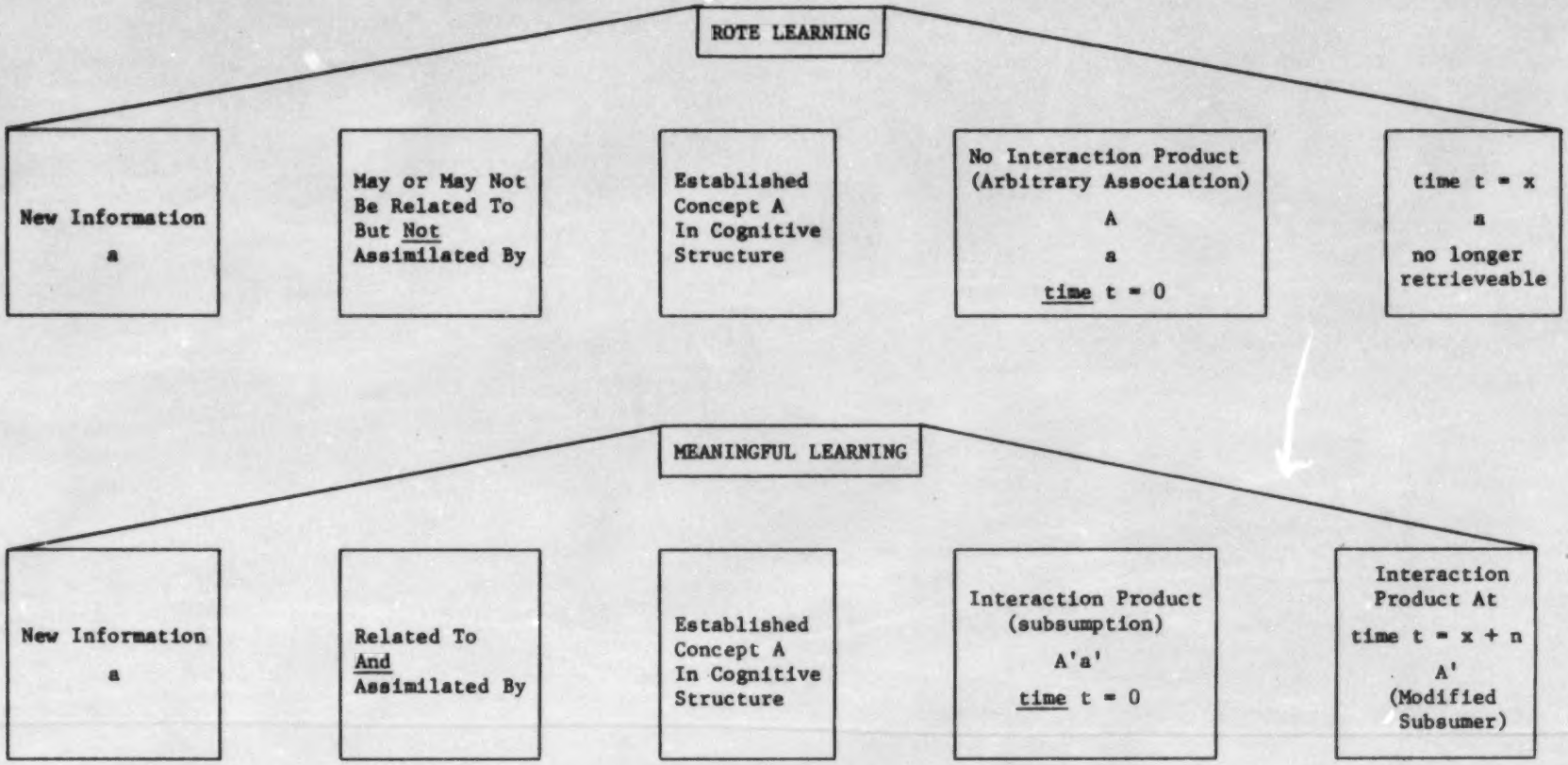

Fig. 4. Rote learning has less effect on established cognitive structure than meaningful learning. Rotely learned material is also forgotten sooner.

If material is learned rotely, even though it has the potential of being learned meaningfully, it does not affect previously learned concepts in cognitive structure and is soon forgotten. In contrast, material that is learned meaningfully, that is connected to previously learned information in a non-arbitrary and substantive manner, permanently changes the meaning of the previously learned information and is itself changed. This newly learned material is remembered longer. Even after the newly learned information is itself forgotten, the concepts to which it was related remain changed (further differentiated). The process of meaningfully learning material by relating it to previously learned more general and broader concepts (Fig. 4, A) Ausubel calls subsumption. The concept to which the newly learned material is related (Fig. 4, A) is the subsuming or superordinate concept. Even though the newly learned information (A'a') is eventually forgotten, the subsequent learning of related information is facilitated ($A' + a_2 \longrightarrow A'' a'_2 \longrightarrow A''$). This facilitation of new related learning and the use of concepts in problem solving is what gives meaningful learning its great merit over rote learning.

In the process of meaningful learning, subsumption assures a change in previously learned concepts as new information is assimilated into existing relevant concepts.

As meaningful learning proceeds, concepts in cognitive structure are elaborated and differentiated. This progressive differentiation is aided by properly ordering the information to be learned. Related concepts that are to be learned should be presented from the most general to the most specific--that is, from the most inclusive to the most subordinate. This is achieved in part when Level I modules are studied before Level II modules. This aspect of curriculum organization is the most difficult and will be discussed in the next section.

Progressive differentiation is facilitated by ordering the presentation of the new material from the most general to the most specific.

It is important that the instructor and the instructional material encourage students to relate new information to information already stored in cognitive structure. The process of progressive differentiation results from the elaboration of concepts as well as from obtaining the maximum number of connections among concepts.

In the course of concept learning and differentiation, conflicting meanings may arise. In learning about land treatment, for example, many students confuse the waste treatment method (irrigation, overland flow, or rapid infiltration) with the application technique (spray, ridge and furrow, corrugations, or flood). It is important for the students to resolve this confusion between concepts. The instruction should be carefully designed to facilitate this integrative reconciliation.

> Selection of waste application systems should not be confused with the selection of the method of land treatment (i.e., spray or surface irrigation, overland flow, rapid or moderate rate infiltration, etc.). Selection of treatment method is a more basic decision which then leads to the selection of application system alternatives. The factors contributing to treatment method evaluation are discussed in several other modules . . . and will not be discussed here in any detail. (Loehr et al., p.)

This passage from Module 12 (II-9), "Waste Application Systems," is a direct attempt to resolve any confusion that might arise, and thus hasten integrative reconciliation. The concept of method of land treatment and method of application is integratively reconciled under the more inclusive concept of land application system.

This section has indicated a theoretical basis for meaningful concept learning and the way concepts can be arranged to facilitate meaningful learning of the fundamental principles or concepts of land treatment. This module began by indicating that success at problem solving is simply an act of meaningful learning. The problem solver gathers relevant information and internalizes it. This information is related to previously learned concepts in cognitive structure. The solution or solutions are a measure of the ability of the person to marshal, select and organize the previously learned relevant concepts. This is an act of meaningful learning that reflects the degree of differentiation and integrative reconciliation in the learner's cognitive structure. The next section discusses choosing concepts for presentation and choosing the instructional techniques to use in the presentation.

In the course of learning and differentiating, conflicting meanings may arise. The clarification of this confusion leads the learner to reconcile the inconsistencies in a process called integrative reconciliation.

CURRICULUM AND INSTRUCTION

The object of an educational program, whether it is a university course, seminar, in-service or short-course, workshop, or symposium, is to have the audience or students meaningfully learn the conceptual structure of a discipline. The ideal situation is schematized in Figure 5. In this figure the conceptual structure of the discipline is transferred directly to the learner.

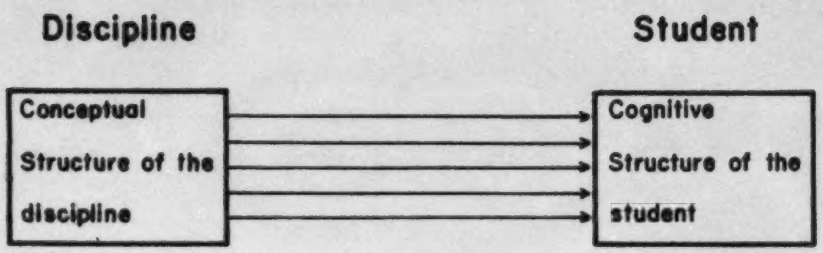

Fig. 5. An idealized representation of the educational process in a discipline (after Novak, 1977).

The usual knowledge transfer situation is represented in Figure 6. This is the case in most university courses, workshops, seminars, and symposia. The instructors or speakers have not analyzed the discipline and are not quite sure what the intended learning outcomes* should be. In these cases, also, the courses are led by one or several people who lecture to the learners. In situations like this, little meaningful learning or change occurs in the student's cognitive structure. Occasionally, the discipline has been analyzed and a "laundry list" of intended learning outcomes is delineated. Also, an instructor will assign outside reading or present a film or a speaker. The main vehicle for learning, however, usually remains the instructor (or speaker at a seminar or symposium). This acts as a filter between the learner and the conceptual structure of the discipline. The learner still has only one route to follow and must maintain the pace of the rest of the group.

Although the educational objective is for students to meaningfully learn the conceptual structure of a discipline, many programs are set up with the instructor as the main vehicle for learning.

*In many college courses, curriculum planning is taken as almost synonymous with preparation of behavioral objectives (Mager, 1962). Unfortunately, behavioral objectives may give neither student nor instructor a clear conception of the concepts to be learned, for this is not the focus of "Magerian" psychology.

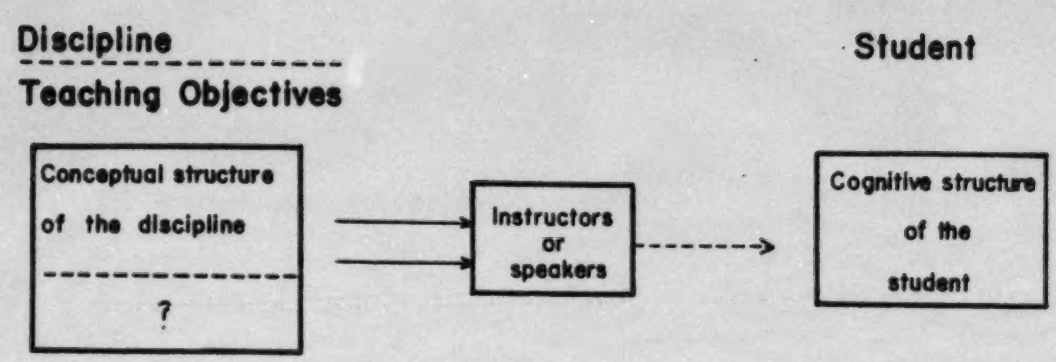

Fig. 6. The educational process in which the instructor or speaker acts as the sole information source. This is a situation that is found in most university courses, scientific meetings, symposia, and seminars (after Novak, 1977).

Figure 7 represents the curriculum and instruction aspects of Land Application of Wastes Educational Program. The discipline has been analyzed and a conceptual hierarchy developed. Several different sources of information are available to maximize the learner's meaningful learning. The instructors or tutors direct the participants to the varied sources of information. The modules have been developed to provide the main body of knowledge. Each module lists the intended learning outcomes. The design problems and the way the group handles the design problems is an indication of the actual learning outcomes.

The Land Application of Wastes Program is designed to maximize the students' meaningful learning. The modules contain the main body of knowledge, and planned activities aid the learner in integrating new concepts.

Figures 6 and 7 imply that there is a difference between curriculum decisions and instruction decisions. What to teach could be the same in both of the schema with how it is taught being different. The first decision to be made in the development of new learning material is what is to be taught. This also happens to be the most difficult decision and the one on which there will be the least agreement. Table 1 indicates the concepts associated with the fate of phosphorus in land treatment.

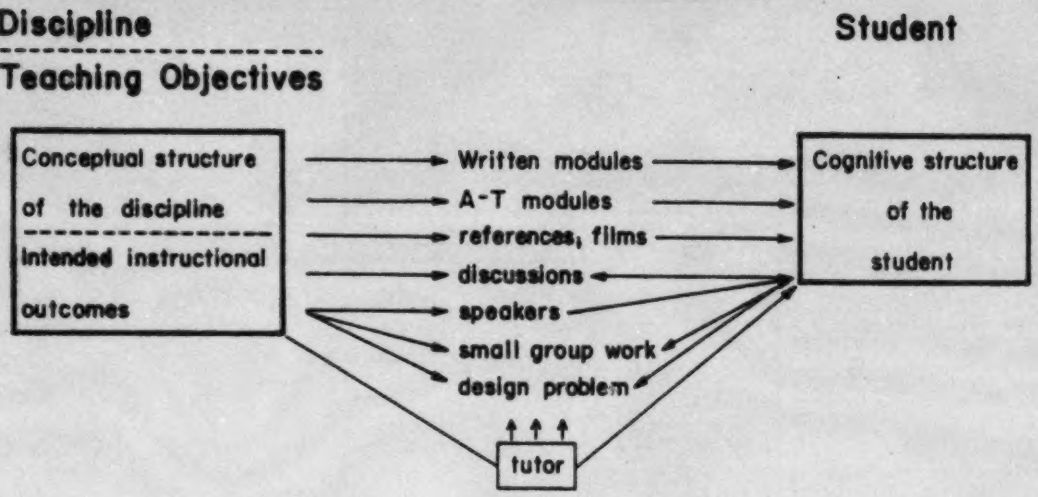

Fig. 7. The educational process in an individualized program. The learner develops his own program with guidance from the tutor. This program depends upon the background of the students.

TABLE 1

CONCEPTS CONCERNING PHOSPHORUS IN LAND TREATMENT

Origin in waste	Isotherms
Organic	Residence time
Inorganic	Solubility
Detergents	Soil air
Orthophosphate	Availability
Soil pH	Saturation
Soil texture	Irrigation systems
Adsorption	Overland flow systems
Soil minerals	Rapid infiltration systems
Aluminum	
Iron	Harvest
Calcium	Erosion
Precipitation	Runoff

Figure 8 shows those same concepts arranged in a hierarchy. This is the basis for the development of a module. The development of this hierarchy was preceded by a decision that it is important that a person learning about land application of waste know the basic principles concerning the fate of phosphorus in these systems. This value judgment also implies an intended learning outcome. Additional learning outcomes in the same concept area are that upon completion of the module, the participant should be able to:

The difficult curriculum decisions involve value judgments which imply an intended learning outcome.

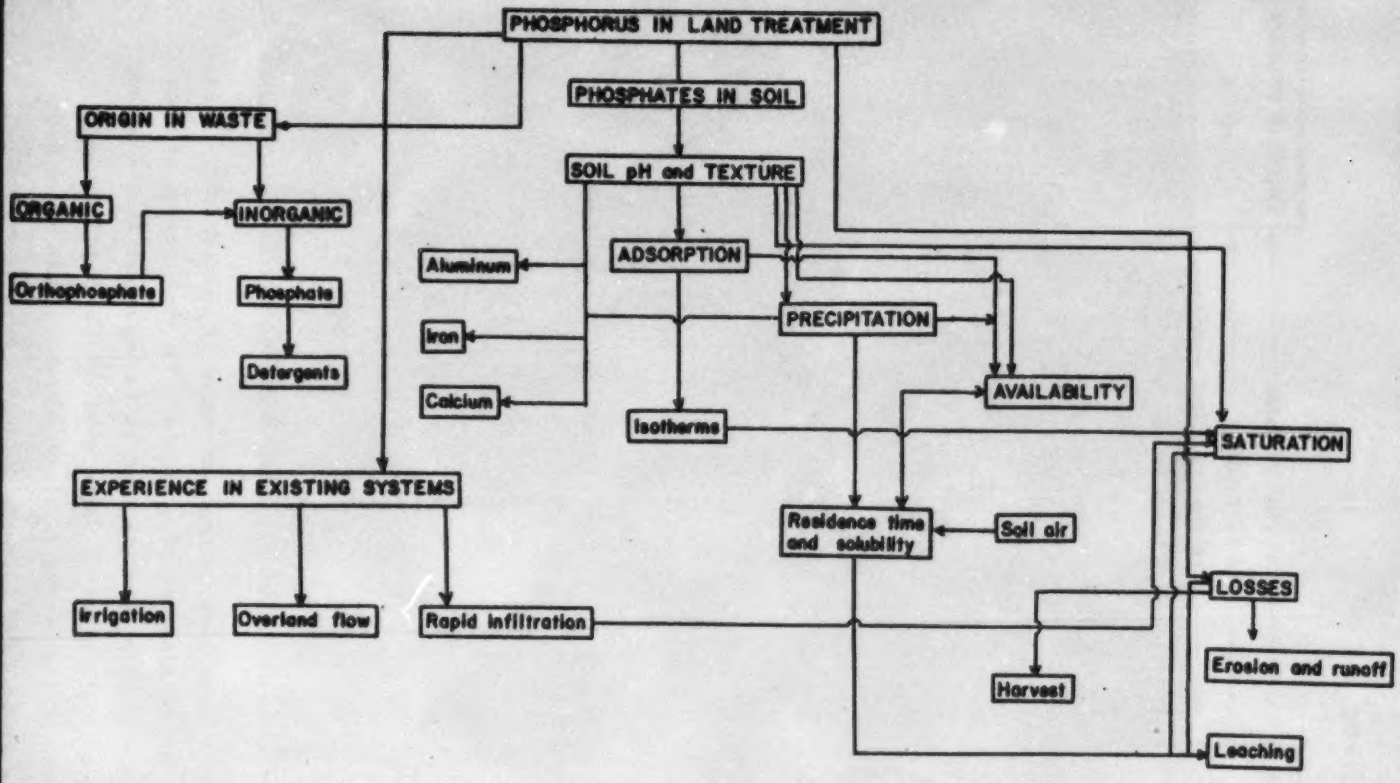

Fig. 8. Phosphorus Considerations (Module II-2) conceptual hierarchy.

(1) Describe common loading rates of phosphorus in land application systems and where the various forms of phosphorus found in wastewater come from.

(2) Describe those soil conditions which favor the retention of phosphorus.

(3) Discuss the availability of phosphorus in the soil and how phosphorus is retained in the soil in various forms.

(4) Discuss how the land application site should be managed to enhance phosphorus removal.

(5) Discuss the relative effectiveness of spray irrigation, overland flow, and rapid infiltration systems for phosphorus removal.

These have been included in the Phosphorus Considerations module as "Objectives." Note that each of the above objectives involves several concepts; we have underlined the key concept for each objective.

Instruction is planned and written after the conceptual hierarchy and the intended learning outcomes are developed. The instruction can be in the form of a lecture, written module, A-T module, demonstration, experimentation, or a combination of these. It is important that the learner has access to the intended learning outcomes (objectives) so that he can check to see if his learning has been effective. This means that the outcomes may have to be sharpened so that they can be useful. For example, compare the following statements:

Intended outcomes must be clearly defined in the instructional sequence. When presented as the initial part, it enables the learner to check the effectiveness of the learning experience.

(a) The student should understand adsorption isotherms.

(b) The student should be able to explain the usefulness and the limitation of adsorption isotherms in determining phosphorus retention of soil.

The intended learning outcomes should be the initial part of an instructional sequence.

As stated in the previous section, concepts should generally be presented from the superordinate to the subordinate and the relationships among concepts made clear. Novak (1977) suggests that whenever a new concept area is being introduced the instructor use a cognitive bridge to facilitate meaningful learning. Cognitive bridges are short pieces of learning material that serve to link the subsequent information to relevant concepts which are already stored in the learner's cognitive structure.

Cognitive bridges, or linking pieces of learning material, sensitize the learner to the important concepts in instruction, and enhance meaningful learning.

They also help sensitize the learner to the important concepts that are in the instruction and their relationship to one another. The summary that is located at the beginning of each written module serves this bridging function. The written and A-T modules often contain a diagram that serves as a cognitive bridge for the remainder of the module. An example of one of these diagrams from the Nitrogen Considerations module is shown in Figure 9. A cognitive bridge is as important in a lecture or report as it is in any kind of instructional format.

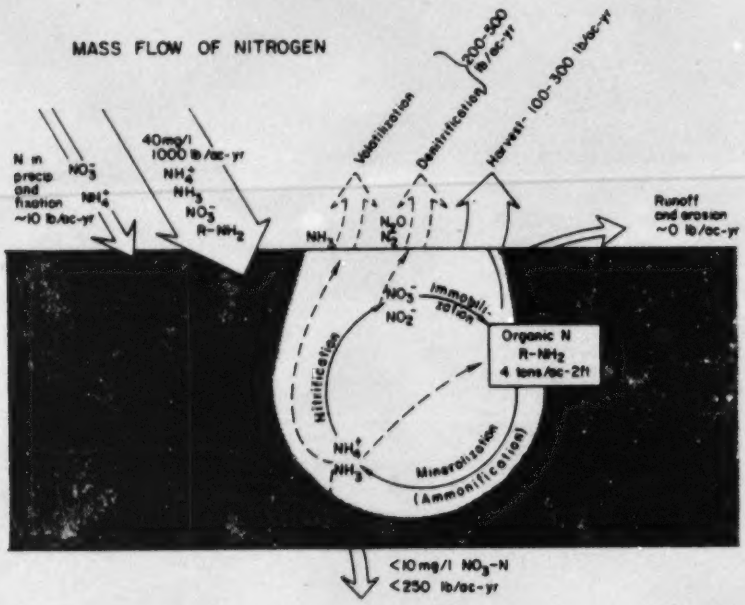

Fig. 9. A diagram introduced early in the "Nitrogen" module to serve as a "cognitive bridge," linking new knowledge to be learned with concepts already familiar to the students (i.e., the general form of a nutrient cycle).

After the development of the cognitive bridge, the remaining part of the instruction is developed. Figure 10 shows the instructional sequence in the Phosphorus module. Notice that the instruction returns to the main concepts several times; this aids the learner in progressive differentiation of his concepts. Not indicated in the figure are the references to other concepts in other modules to facilitate further differentiation and integration. After an instructional sequence is developed, it should be tested and revised. This is often necessary to do several times. In our program, several man-months were required to develop an effective instructional product concerning one major instructional sequence such as the module "Phosphorus Considerations" (#19).

Instruction is generated following the development of cognitive bridges and main concepts in the particular module and other modules are repeatedly referred to as means of facilitating differentiation and integration.

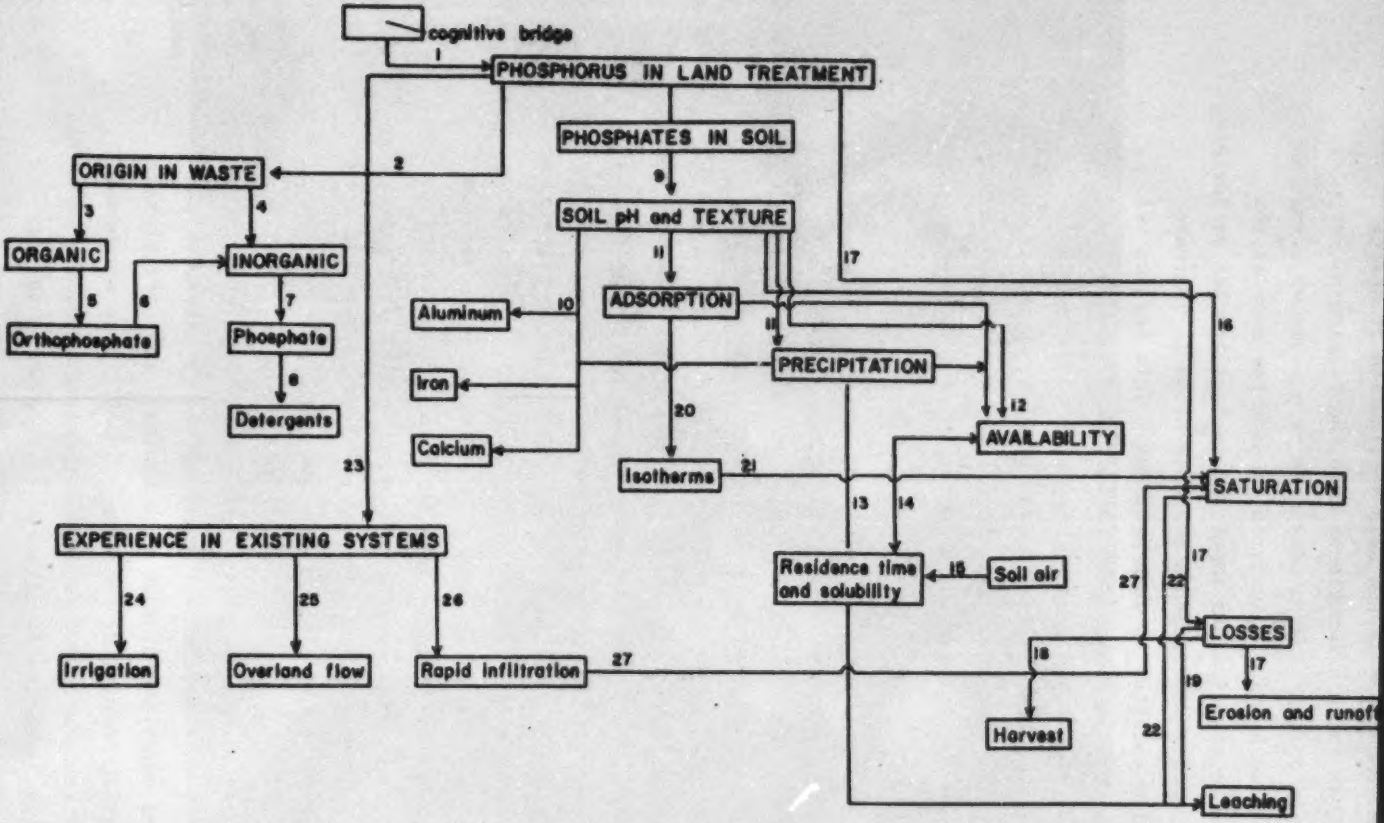

Fig. 10. Phosphorus Considerations (Module II-2) conceptual hierarchy showing the instructional sequences to achieve progressive differentiation through meaningful learning.

COMPONENTS OF EDUCATIONAL PROGRAM AND THE RATIONALE BEHIND THE PROGRAM COMPONENTS

Each of the components in the Land Application of Wastes Educational Program makes a contribution to the meaningful learning of the program participant. When conducted in a workshop format as described in Modules A and B, provision is made for most of the social and psychological factors important to facilitation of learning even with the usually heterogeneous audience of adult learners characteristically enrolled in such programs. This section will describe how each instructional component--written and audio-tutorial modules, the design problem, workgroups, discussions, reference works, speakers, public hearing simulation, and field trips--each contribute to advancing the participants' grasp of concepts important for understanding land treatment of wastes.

Written and Audio-Tutorial Modules

The modules provide the basic instructional package. They are in both the written and audio-tutorial format for several reasons. The written form is less expensive and easier to use as a general future reference. The audio-tutorial modules foster meaningful learning by being received through various senses. That is, each A-T module can be read by using the script provided, heard from that cassette tape, and viewed through the slides.

The A-T modules foster meaningful learning by being presented through written, auditory, and visual modes.

The modules are similar to the chapters of a book. There are several differences, however, between the chapters of a typical engineering text and the modules in the Land Application program. Perhaps the major difference is the division of the modules into two levels with each module in Level I concentrating on a particular superordinate group of concepts, and each module in Level II going into greater detail on those major concepts and tying in subordinate concepts. This cyclical structure serves two functions. First, it conforms to Ausubel's learning theory in that it introduces the subject in a general way which serves to introduce the new concepts and establish linkage with concepts that are already known, facilitating meaningful learning. Second, this arrangement conforms to the procedure used in sewage treatment facility planning. That is, enough information is gathered to develop an initial

The written modules are divided into two levels, the first presenting a general overview, and the second, more detailed information on the broad concepts mentioned in Level I.

feasibility plan. This plan is basically a "first cut" which indicates the viable options and the approximate cost of each. This initial feasibility study is then refined with further study and information and a detailed plan is developed which can be used to decide on the best option.

In addition to conforming to Ausubel's learning theory, this approach works well in the design of an initial and final feasibility study for a sewage treatment facility.

Each module also lists objectives and is preceded by an initial summary. Each module also specifies the differences and relationships among the particular concepts under discussion and the information in other modules. There are extensive cross references among the modules.

In this discussion, the main emphasis has been on the concepts that are presented in the modules. The modules also enable the reader to develop a detailed plan of a land treatment system and compare them for cost effectiveness to a conventional system for a particular design problem. This, however, can only be accomplished with the aid of additional references.

Workgroups and Tutors

The use of small (3 to 5 participants) workgroups has merit on theoretical grounds for several reasons. From group theory we know that many people will accept challenges as a group that they would avoid as individuals. The social and psychological support that comes from working with peers is well documented. However, group work can be counterproductive if goals are not well defined and the group is leaderless (or led in directions that move away from the learning goals). Staff tutors can assist in giving direction to group efforts, but leadership of the group should be delegated to one or more of the participants.

Another useful aspect of group work is that comparatively speaking, the group members are closer to one another in their conceptual adequacy than they are to the staff. Therefore, group members can often recognize a missing concept or a misconception that is causing a peer member trouble, whereas a staff member may not see the difficulty. Furthermore, there is less psychological risk in admitting ignorance of some concept or fact to a peer who also admits his limitations than is the case in admitting ignorance to a staff member (who may also be a much younger person). Admitting ignorance or lack of understanding is the first step needed for learning.

Finally, as the group develops cohesiveness and an identity of its own, "affiliative" motivation may occur where the individuals strive to have their group come up with the "best" design or to excel in some other way. With strong group spirit, there is also no longer a fear of asking searching questions of the staff. This, of course, contributes to the challenge that workgroup activities present to the staff, but the rewards for everyone is in the satisfaction with the learning that occurs.

Design Problems

At the beginning of this module we stated that problem solving success is to a great extent a function of the degree of differentiation and integration of the concepts relevant to the problem situation. This is especially so if a standard solution to a waste treatment problem is sought. The concepts in cognitive structure guide the problem solver in deciding on the kind of information to gather and the way to put the information together. Thus, the adequacy of the design solution is an indication of the adequacy of the program in relation to the particular audience.

The ability of the learner to integrate the concepts of the design problem into his/her cognitive structure is a reflection of the adequacy of the program.

To be a truly innovative problem solver, however, calls for an ability that is not completely understood. Innovative or creative solutions still reflect the adequacy of the previously learned concepts. The person who develops the best solutions, however, seems to be able to develop new relationships among concepts. That is, they reorganize the relevant information to develop the innovative solution. This kind of person is quite rare. As educational programs begin to stress meaningful concept learning, this kind of person may become more common since building relationships among concepts is emphasized.

The development of new relationships among concepts leads to innovative and creative solutions.

The Difference Between A Design Workshop and the Land Application of Wastes Educational Program

The purpose of a design workshop (or design manual) is to provide the participants with design options and parameters. This might be adequate in a subject area, such as conventional treatment, in which the participants already possess a significant amount of the relevant cognitive structure. In this situation, the solution of the design problem would be the primary objective of the workshop participants.

The basic purpose of the Land Application of Wastes Educational Program is to help the participants learn the varied concepts that relate to land treatment. These concepts are generally not known by the members of the waste treatment community. The solution to each land treatment problem is unique because there are such a large number of complex variables involved. Learning the basic concepts concerning land treatment will allow the consulting engineer, regulatory agent, or the other professionals that work in this area to deal with these variables in developing an effective system. The design approach is detailed in the modules (i.e., "Design Procedures for Land Application of Wastes") and many of the parameters that enter a design are specified. The necessary tables and figures to complete a detailed design, however, must be obtained from other sources, such as the references provided for the workshop. The design problem is included in the workshop to promote concept learning and to ensure that the learned information can be applied to the practical situation.

The purpose of the Land Application of Wastes Program is to present the participant with new information in land treatment in such a way that practical application is facilitated.

Discussions

The discussions (shown in Figure 11) that are held in both the workgroups and large groups help the learners integrate the new learning material into cognitive structure. Discussion helps resolve conflicts about the meaning of the information and its relationship to other previously learned concepts. When a person can translate a new concept into his own words the concept truly is his.

The discussions also help the participant recognize gaps in his knowledge and in many cases fill the gaps. This may occur even for the person who does not verbally contribute to the discussion.

Discussions help learners to integrate new material into cognitive structure by resolving conflicts, and also pointing out gaps in knowledge which the learner may then be able to fill.

Reference Works

The reference works (see Figure 12) that are available at a 5-day workshop serve three functions. The first function is to provide additional information in a particular concept area. This is important in an individualized program to foster additional learning for those people who desire it.

Fig. 11. Discussion groups help learners integrate new learning material into cognitive structure.

Fig. 12. Reference works provide additional information in a concept area, provide basic information to fill in the gaps in cognitive structure, and are used to ascertain information related to the design problem.

The modules in the land treatment program were developed based on the assumption that the reader would have a minimum, but substantial background in waste treatment and also have some minimal training in or knowledge of several basic concepts related to soils, biology, and mathematics. If one or more of these areas is completely unfamiliar to the learner then the subordinate concepts related to these general concepts will be very difficult to learn meaningfully. However, the reference books can provide basic information to fill in the gaps in cognitive structure or to refresh participants' knowledge in basic areas that may have been studied some years ago.

Reference works provide additional concept information, fill in gaps in cognitive structure to ameliorate meaningful learning, and ascertain factual material necessary for the design problem.

Finally, the references are used to ascertain particular information related to the design problem. This kind of reference includes maps, climatic information in detail, soil surveys, and detailed cost curves.

Speakers

The speakers (one of which is shown in Figure 13) provide up-to-date information on topics that are of interest to the particular audience. The presentations will be more meaningful if the detailed or technical talks are given towards the latter part of the workshop. The participants should have functional concepts established or elaborated that will allow them to see new meaning in the lectures and to ask probing questions. Even lectures that might have been considered a review of previously known information will take on new meaning now that the participants are engaged in active problem solving on a land application design problem.

Speaker presentations given towards the latter part of the workshop will be more meaningful to the learner because of a wider set of concepts.

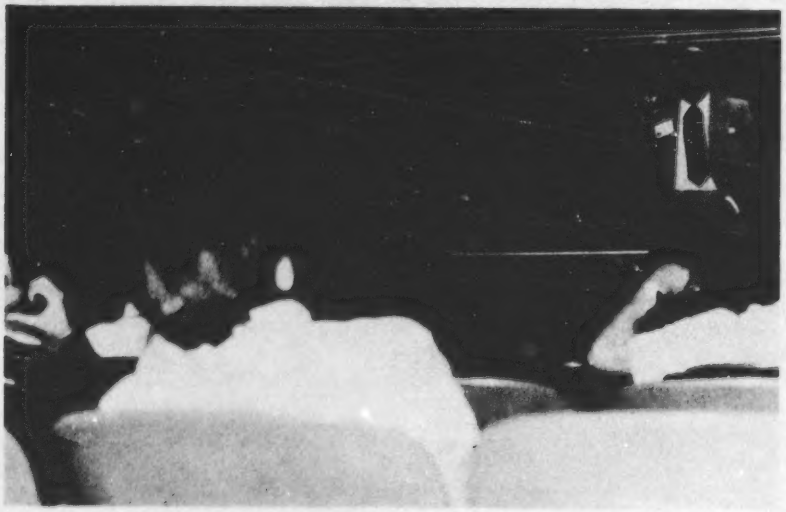

Fig. 13. Speakers provide up-to-date information on topics that are of interest to the particular audience.

Public Hearing Simulation

Although the module, "Societal Constraints," discusses community reactions to a land treatment or any new waste treatment plan, it is difficult to relate the actual experience of a public hearing by using textual material alone. The public hearing (pictured in Figure 14) is so unlike any other situation (except an oral examination) that most people do not have the cognitive and attitudinal framework to make the text meaningful. The public hearing simulation is much more effective in conveying the totality of feelings and variety of questions that are often present during an actual public hearing. If most of the participants in a workshop have had previous experience with public hearings, this portion of the workshop may not be necessary.

The simulated public hearing provides the learner with the necessary information to make the actual event a meaningful cognitive experience.

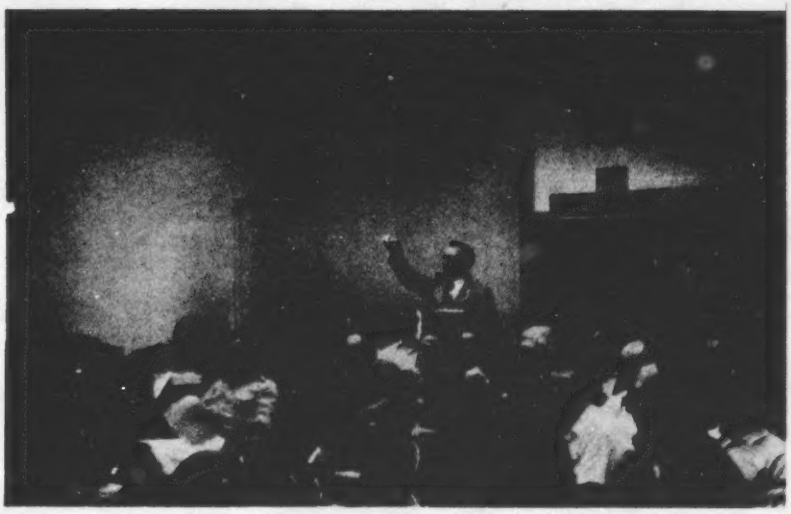

Fig. 14. A simulated public hearing.

Integration of Activities

This section has discussed how each segment of the Land Application of Wastes Program fits into the total educational program. Reference was made, however, primarily to the concept learning aspects of the program. The varied activities and sources of information serve another essential purpose. They serve to maintain participant interest in the intensive week long program and to foster interaction among the participants and between the participants and staff. Very few people could study only the written modules for the entire time of the workshop. The speakers, discussions, public hearing simulation, and small-group work are additional learning modes that can be effective and can serve to maintain enthusiasm throughout the workshop period. The matrix of activities designed into the workshop program, when conducted according to the guidelines presented in Modules A and B, should not only lead to lasting gains in understanding of land application systems but also should provide pleasant memories and a few new lasting friendships. Evaluated one or two years later, we believe most participants will look back on their week of study and interaction as one of the most valuable weeks of their professional careers. It is our intent to continue to evaluate and modify the Land Application of Wastes Program and your critical feedback to us would be appreciated.

Though the activities are designed for effective concept learning, they also serve to maintain participant interest in the intensive week long program and foster social interactions.

ALTERNATIVE FORMATS FOR THE LAND APPLICATION OF WASTES WORKSHOP PROGRAM

Modules A and B in this Instructors' Program are concerned with planning and conducting a four and one-half day workshop. Although this time frame has been found to be the most desirable* for introducing land treatment to the participants, not all sponsors may be

*Our initial thinking was that a two-week workshop was the optimal time period for training in land application systems. However, questionnaire responses from a sample of our prospective audience were in 100 percent agreement that a two-week time period would be undesirable with their schedules. Most workshop participants have indicated that more time was needed than was available in the 4-1/2 day program but that they could not schedule more time with their workloads. The time period seems to represent a reasonable compromise for most practitioners in waste treatment careers.

willing or able to conduct a week long program. This section, therefore, indicates modifications that can be made in the workshop curriculum so that it can be conducted in a shorter period of time. Consulting engineers, regulatory agents, and other state and federal specialists in waste treatment are the anticipated audience of the workshop discussed in Modules A and B. The program, however, can be tailored to meet the particular needs of a more specialized audience--engineering students or regulatory agents, for example. This portion of the module also discusses modifications of the workshop format to meet the needs of particular specialized audiences.

A shorter workshop or one geared toward a specialized audience mandates modifications, although the format remains essentially the same.

It should be noted, when studying the modifications, that the variety of activities remains essentially unchanged. All of the programs contain individualized module study time, small-group work and discussion, large-group discussion, and lecture presentation. The program should not rely on a simple lecture or a reading format in order to save time. A workshop that contained only lecture or reading of modules would have very little chance of success because of the differences in the conceptual background of the participants in this subject matter area.*

Table 2 indicates a four and one-half day workshop schedule that has been used in Modules A and B of this package. Proposed schedules that follow can compare to this basic curriculum. Even using this four and one-half day schedule, the workshop participant cannot usually study all of the modules. This means that additional study after the workshop will be required in order to master all of the concepts. As the schedule is shortened, fewer of the modules can be studied adequately during the workshop, which increases the need for post-workshop study.

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*Informal feedback has been strongly negative from workshop participants in programs that "read modules" to the entire group and gave supplementary lectures only.

TABLE 1

SCHEDULE FOR A TYPICAL WORKSHOP

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 a.m.	Registration, Welcome, Introduction to Program	Level I Design Procedure-Limiting Design Factors	Introduction to Level II	Group Discussion if needed-alternative systems	Prepare Level II Design
9:00	Written & A-T Modules, Design Problems	XXXXXXXXXX	Level II XXXXXXXXXX	XXXXXXXXXX	Presentation of Level II Designs
9.30		XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	
10:00	Coffee	Coffee	Coffee	Coffee	Coffee
10:30	Level I XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	Discussion & Evaluation
11:00	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	XXXXXXXXXX	↓
11:30	XXXXXXXXXX	Complete Level I Topics	Discussion-Pathogens & toxic elements (or nitrogen)	XXXXXXXXXX	
NOON	Lunch	Lunch	Lunch	Lunch	Adjournment
1:00 p.m.	Speaker	Speaker	XXXXXXXXXX	Speaker	
2:00	XXXXXXXXXX	Prepare Level I Design	XXXXXXXXXX	XXXXXXXXXX	
3:00	XXXXXXXXXX	Presentations of Level I Designs	Field Trip (optional)	XXXXXXXXXX	
4:00	Design Problem Definition & Review of Format & Early Problems	Discussion of cost effectiveness & pollution control efficiency	↓	Level II Modules, Complete Public Hearing	
5:00					
7:30	Evening Program				

XXXXXXXXXX - denotes time set aside for individualized study with tapes, slides, written material and other prepared material. Individual course instruction and tutoring are also available at these times.

One way to reduce the time commitment needed is to supply with each design problem the least cost estimate for a conventional system. This should not detract from the basic purposes of the workshop but will save the time used to plan and cost-out a conventional system. Providing the cost of each component, rather than a total cost, allows the participants to include part of the conventional system in their land treatment plan as a pre-application procedure. Table 3 provides a sample of "conventional treatment costs" for the Santa Maria problem given in appendix A of Module A.

Inclusion of cost components for conventional treatment minimizes the time necessary to satisfy the design problem.

TABLE 3

SAMPLE OF CONVENTIONAL TREATMENT COSTS FOR SANTA MARIA DESIGN PROBLEM

	Costs (¢/1000 gal)[a]		
Treatment Process	Capital	O & M	Total
Preliminary	0.31[b]	0.41	0.72
Primary	0.80	0.55	1.4
High Rate Activated Sludge	2.2	2.5	4.7
Biological Nitrification	2.2	1.8	4.1
Biological Denitrification	1.4	2.5	3.9
Filtration	2.5	1.9	4.4
Disinfection	0.2	0.9	1.1
Anaerobic Digestion	0.57	0.22	0.78
Dewatering	0.61	1.2	1.8
Sludge Disposal	--	--	3.0[b]
Administration	--	0.7	0.7[b]
	10.71	11.98	26.6

[a] Costs are based on 1973 figures. For accurate comparison with land treatment costs these costs should be adjusted accordingly. Except where noted, the costs are from Van Note, et al., 1975.

[b] Figures from Pound, et al., 1975. These figures are given in totals only.

The Three-Day Workshop

The schedule for a three-day workshop is indicated in Table 4. Table 5 summarizes the duration of the various activities and compares them to the standard schedule. The lecture and large-group discussion time is almost cut in half but only about 20 percent of the module study and design group work is cut from the basic schedule. The sponsors may want to break up the long afternoon of study on day one by providing beverages for a break at 3:30.

This schedule may be especially effective for participants who have had experience with land treatment. The four and one-half day schedule can be a bit long for this kind of person, leading to boredom on day four. There is, however, no field trip provision and no extra time in the three-day program. The participants who are unfamiliar with land treatment must realize, with this schedule, that they are being introduced to the concepts and design aspects related to land treatment. The reduction in study time is small enough, however, that the overall understanding of the basic concepts for this group will not be seriously affected using the three-day schedule compared to the four and one-half day program.

For participants with experience in land treatment, a three-day workshop is feasible, with less time for lecture and discussion, and with elimination of the field trip. Concept introduction and overall understanding should not be seriously affected with this schedule.

The Two-Day Workshop

The two-day workshop schedules presented in Table 6 allow the participant to study the Level I modules and work on the Level I design problem in detail. The Level II portion of the workshop, however, is severely curtailed compared to the basic schedule. Table 7 compares the two-day and four and one-half day programs.

In a two-day workshop, Level I is presented in full, but Level II is used to enable participants to examine only a few aspects of land treatment in detail.

It is suggested that the Level II portion of the program be used to enable the participants to examine only a few particular aspects of land treatment in detail. These aspects could include nitrogen control, crop selection, and climate and storage of wastewater. Nitrogen is of major importance because it is often the limiting factor in a land treatment problem. Crop selection affects the management of a site, infiltration capacity of the soil, application rate, control of various nutrients (i.e., nitrogen and phosphorus) and potentially toxic elements, and income for the facility. It is therefore an important subject and ties in well with the nitrogen module. The climate in an area affects all aspects of land treatment--application season, growing season, nutrient control, soil moisture, and storage. Thus,

TABLE 4

SCHEDULE FOR A THREE-DAY WORKSHOP

	Day 1	Day 2	Day 3
8:00 a.m.	Registration		
8:30	Introduction to Program	Finish Level I. Hand in Summary Sheet	Level II. XXXXXXXXXX
9:00	Hand out Design Problems and Summary Sheets		
9:30		Presentation of Level I & Introduction to Level II. Hand out Level II Summary Sheets	
10:00	Level I. XXXXXXXXXX		
11:00		Level II. XXXXXXXXXX	
NOON	Lunch	Lunch	Lunch
1:00 p.m.	Speaker	Speaker	Level II. XXXXXXXXXX
1:30	Level I. XXXXXXXXXX		
2:00		Level II. XXXXXXXXXX	Presentation of Level II Designs
3:00			Evaluation Session Certificates
4:00		Group Discussion Nitrogen	Adjournment
Evening	Evening Program	Evening Program	

XXXXXXXXXX - denotes time set aside for individual study and group work.

TABLE 5

SUMMARY OF THE DURATION OF VARIOUS ACTIVITIES IN A THREE-DAY WORKSHOP COMPARED TO THOSE IN A FOUR AND ONE-HALF DAY WORKSHOP

Activity	4 1/2-Day	3-Day
Introduction	2.0	2.0
Level I Modules*	9.0	6.5
Level II Modules*	10.0	8.5
Lectures & Large-Group Discussions	10.0	5.5
Field Trip	2.0	- -
Evening Program.	3.0	2.0
Total Hours.	36.0	24.5

*Small-group work and study time.

TABLE 6

SCHEDULE FOR A TWO-DAY WORKSHOP

	Day 1	Day 2
8:00 a.m.	Registration	
8:30	Introduction to Program. Hand out Design Problems, Summary Sheets, & Level I Procedure	Discussion of Level I. Introduction to Level II Problems and Procedure
9:30	Level I. XXXXXXXXXX	Selected Level II Modules & Aspects of Design
NOON	Lunch	Lunch
1:00 p.m.	Level I. XXXXXXXXXX	Discussion of Nitrogen
2:00		Level II. XXXXXXXXXX
4:00	Speaker and Discussion	Presentation of Level II Design. Evaluation and Certificates
Evening*	Finish Level I. Hand in Summary Sheets	

*In a two-day workshop with no evening work, Level I should be completed and summary sheets handed in at 5:00 on the first day.

XXXXXXXXXX - denotes time set aside for individual study and group work.

TABLE 7

SUMMARY OF THE DURATION OF VARIOUS ACTIVITIES IN A TWO-DAY WORKSHOP COMPARED TO THOSE IN A FOUR AND ONE-HALF DAY WORKSHOP

Activity	4 1/2-Day	2-Day
Introduction	2.0	1.5
Level I Modules*	9.0	5.5 +**
Level II Modules*	10.0	4.5
Lectures & Large-Group Discussions	10.0	4.0
Field Trip	2.0	- -
Evening Program	3.0	- -
Total Hours	36.0	16.5+

*Small-group work and study time.

**With evening work there is additional time to complete Level I.

"Climate and Wastewater Storage" is important to study in conjunction with nitrogen and the crop selection aspects of land application. The aspects of land treatment on which the participants concentrate may vary somewhat depending upon the limiting factor found in the Level I portion of the design problem and upon particular regional or group interests. The topics suggested, however, fit together well and are very important.

"Nitrogen Considerations," "Crop Selection" and "Climate and Wastewater Storage" modules present important aspects of land treatment, and are useful in a limited Level II presentation when used in combination.

The introduction to the Level II portion of the workshop should indicate that only certain aspects of land treatment will be examined in depth. The other aspects will have to be studied independently after the workshop. The participants should study the modules with two purposes in mind. The first purpose, of course, is to learn the basic concepts and relate them to other concepts in cognitive structure. The second purpose is to complete the design problem in relation to the particular aspects chosen for study. For example, if nitrogen is chosen as one of the areas of concern for Level II, the participants should further differentiate the understanding of the nitrogen control concepts and use these concepts in their design problem. Since nitrogen is often the limiting factor in land treatment, the ideas gained studying the efficient and effective control of nitrogen should allow the participants to reduce the necessary land area in the design problem for control of this nutrient. Thus, the aim in a two-day workshop, as in the longer workshops, is to find the most efficient method of treating a particular waste at the least cost.

The goal in a shortened workshop remains the learning and integration of basic concepts, and the completion of the design problem.

The two-day workshop without the evening portion approaches the minimum time possible to develop an adequate workshop, that includes both Level I and II. The design problems for this kind of workshop ought to be quite straightforward. One or two sites for each possible kind of land treatment could be indicated on a map of the design area. This would save time otherwise needed to examine soil surveys and topographical maps.

Variations in Program Design

There are an infinite variety of possible programs that can be developed using the basic Land Application of Wastes Program. This final section summarizes some of the variations that have been tried and some interesting possibilities that have not yet been tested.

A regulatory agent basically reviews facility plans that consulting engineers have developed. A workshop for regulatory personnel, therefore, might schedule a time for design problem review. During this time, at the end of Level I or Level II, workgroups exchange plans and supporting material. Thus, those people who worked on design problem A would review design problem B, and so on. There are only a few hours leeway in a four and one-half day workshop for this kind of activity. The groups that have tried workshops of this kind emphasize the need for an extensive amount of supporting documentation, that is, climatic information, soil surveys, topographical maps, land use, and cost documents.

Variations may include scheduled time for design problem review for regulatory personnel. and the expansion of the curriculum to a college course for seniors and graduate students.

The Land Application of Wastes program has been used in college courses for seniors and graduate students. This variation allows the student time to study all of the modules and many of the references indicated in Module A of this Instructor's Program over an academic quarter or semester. Most colleges have an audio-visual center that can check out the A-T modules to students on request. The basic plan of the course is to have the students study one of the modules and supporting material for each class. Discussions can be conducted during class time, or assigned as an extra-class requirement, and the design problems can be worked on in small groups. The presentations or design solutions can be written up in more detail than is possible during a four and one-half day workshop. Quizzes and examinations have been incorporated into some of the courses. A novel design problem can also be used to evaluate student achievement, as "take-home" exam or as a class exam with necessary raw data provided.

Special theme workshops can be planned using various modules from the Land Application of Wastes Educational Program package. Themes such as nutrient behavior, public acceptance, and public health or the hydrological aspects of land treatment have been suggested as the central topics for workshops. These workshops could be one to two days in duration. It is important when planning a workshop of this type to include the variety and mix of activities necessary to maintain interest and promote meaningful learning. The participants in a particular subject workshop must know the basic land treatment concepts in order to learn the particular information on the chosen topic. If the participants do not have this basic information then the Level I modules and design problem would be appropriate. In all cases, it is important to have the participants use the concepts presented in the workshop to solve a design problem or a series of shorter problems for the reasons that were discussed earlier in this module.

CONCLUSION

This module has indicated many of the educational and psychological concepts that guided module development of the Land Application of Wastes Program. Meaningful concept learning or the learning of the basic principles is the key to the understanding of land treatment and to effective design of land application facilities. In developing additional material to be presented with the program, it is important to follow the guidelines that will encourage this kind of learning. These guidelines indicate that the discipline should be analyzed to ascertain the important concepts and to construct a conceptual hierarchy. The use of a "cognitive bridge" to introduce the new learning material is helpful to the learner to aid him in linking information that will be learned to relevant existing concepts in his cognitive structure. Working from the superordinate concepts to subordinate concepts and back to superordinate concepts is helpful for the student to achieve integrative reconciliation of concepts.

Each component of the Land Application of Wastes Educational Program contributes to concept differentiation, integration, and reconciliation. The written and audio-tutorial modules, discussions, speakers, references, and presentations all facilitate concept learning and enables the participant to solve a sewage or sludge problem in a cost effective manner. The program provides the participant with a wide variety of learning modalities, accommodates varying backgrounds and rates of learning, and enhances individual and social motivation for learning.

Several variations on the basic four and one-half day workshop are possible and can be effective. All of the variations should contain a mix of instructional techniques using the individualized instructional modules as the basic information source. This allows the participants to maximize their information gain even though their "entry" cognitive structures might vary widely. When the workshop schedule is shortened, modifications in the design problem and in the breadth of coverage of the land treatment modules can help maintain the effectiveness of the workshop period. When used in conjunction with conventional college courses, or as a special college course offering, the individualized nature of the program should be preserved. The Land Application of Wastes Educational Program is a relatively sophisticated educational plan, but offered according to the guidelines set forth in this Instructors' Program, any competent professional should find success with the program.

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PROFESSIONAL STAFF

W. W. Clarkson, Research Associate	Agricultural Engineering
G. S. Friedman, Research Associate	Education
A. C. Plescia, Production Coordinator	Agricultural Engineering

PRINCIPAL FACULTY PARTICIPANTS

W. J. Jewell, Agricultural Engineering	Principal Faculty Advisor
R. C. Loehr, Environmental Studies Program	Project Coordinator
J. D. Novak, Education	Principal Faculty Advisor
E. L. Stone, Agronomy	Principal Faculty Advisor

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